Preliminary Assessments and Site Investigations Report
Lower Pend Oreille River Mines and Mills
Pend Oreille County, Washington
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START-2

Superfund Technical Assessment and Response Team

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PRELIMINARY ASSESSMENTS AND SITE INVESTIGATIONS REPORT
LOWER PEND OREILLE RIVER MINES AND MILLS
PEND OREILLE COUNTY, WASHINGTON

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

Section Page

TABLE OF CONTENTS (CONTINUED)

Section Page

TABLE OF CONTENTS (CONTINUED)

Section Page

TABLE OF CONTENTS (CONTINUED)

Section Page

APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

Acronym	Definition
AC	adjusted concentration
bgs	below ground surface
BLM	United States Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	Contract Laboratory Program
cfs	cubic feet per second
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
DQOs	data quality objectives
E & E	Ecology and Environment, Inc.
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
gpm	gallons per minute
GPS	global positioning system
GRC	Gulf Resources & Chemical Corporation
HRS	Hazard Ranking System
IDW	investigation-derived waste
mg/kg	milligrams per kilogram
MS/MSD	matrix spike/matrix spike duplicate
NPDES	National Pollutant Discharge Elimination System
PAs	preliminary assessments
PCBs	polychlorinated biphenyls
PPE	probable point of entry
QA/QC	quality assurance/quality control
%R	percent recovery
RFC	Resource Finance Corporation
RPD	relative percent difference

LIST OF ACRONYMS (CONTINUED)

Acronym	Definition
SEPA	State Environmental Policy Act
SIs	site investigations
SQAP	sampling and quality assurance plan
SQL	sample quantitation limit
SVOCs	semivolatile organic compounds
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TDD	Technical Direction Document
TDF	Tailings Disposal Facility
TM	Task Monitor
TOC	total organic carbon
µg/L	micrograms per liter
USFS	United States Forest Service
Weston	Roy F. Weston, Inc.
XRF	x-ray fluorescence

LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INVESTIGATIONS REPORT
PEND OREILLE COUNTY, WASHINGTON

1. INTRODUCTION

The United States Environmental Protection Agency (EPA) has tasked Ecology and Environment, Inc. (E & E) to provide technical support in investigating potential contaminant sources to the lower reach of the Pend Oreille River. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) activities included preliminary assessments (PAs) and site investigations (SIs) for 21 mines/mills located near the lower reach of the Pend Oreille River in Pend Oreille County, Washington. The PAs and SIs were conducted under the authority of CERCLA of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986. Of the 21 mines and mills investigated, those identified by The Confederated Tribes of the Colville Indian Reservation to the EPA for assessment under CERCLA include the Pend Oreille Mine/Mill, Grandview Mine/Mill, Josephine Mine, Blue Bucket Mine, Bella May Mine, West Contact Mine and Metaline Mine (Cawston 1999; Passmore 2000). The remaining 16 mines visited were identified by EPA based on the mine/mill location relative to tributaries to the Pend Oreille River and available information regarding volume of ore produced. A list of the 21 mines and mills visited as part of this field event are presented in Table 1-1. The lower reach of the Pend Oreille River is defined for this assessment as the segment of the river beginning at approximately Metaline and ending at Boundary Dam near the International Border (Figure 1-1).

CERCLA PA and SI activities were conducted at 21 mine/mill facilities and tributaries (e.g., creeks and streams) near these facilities that empty into the lower reach (as defined above) of the Pend Oreille River.

The PA and SI are phases in the site assessment process of determining whether a site is releasing, or has the potential to release, hazardous substances, pollutants, or contaminants into the environment and whether it requires further detailed investigations and/or response action that is authorized by CERCLA. The assessment process does not include extensive or complete site characterization, contaminant fate determination, or quantitative risk assessment.

The objectives of the PAs and SIs are to:

- Identify potential contaminant sources to the lower reach of the Pend Oreille River;
- Determine whether the mine or mill is releasing, or has the potential to release hazardous constituents into the environment;
- Document a threat or potential threat to public health or the environment posed by the mine or mill;
- Assess the need for additional detailed investigation and/or response action at the mine or mill; and
- Determine the potential for placement of the mine or mill on the National Priorities List.

The PA and SI field activities were conducted through a combined effort involving Superfund Technical Assessment and Response Team (START) -2 contractor firms, E & E and Roy F. Weston, Inc. (Weston). E & E conducted sampling activities along the lower reach of the Pend Oreille River, a number of its tributaries, and at 5 of the 21 mines/mills visited. Sampling was conducted at those mines/mills where potential sources of contamination were identified and possible impacts to receptors via the surface water migration pathway were observed. E & E activities were conducted under START-2 contract No. 68-S0-01-01 and Technical Direction Document (TDD) No. 01-02-0028. Weston collected mine/mill-specific background samples as determined necessary by the EPA. Weston activities were conducted under START-2 contract No. 68-S0-01-02 and TDD No. 01-02-0001-A.

Activities conducted as part of this assessment include reviewing existing mine/mill-specific information, regional characteristics, collecting receptor information within the mine or mill's range of influence, conducting mine/mill visits, executing the sampling plan, and producing this report.

In accordance with the sampling and quality assurance plan (SQAP), attempts were made to conduct in-situ field screening of metals concentrations at potential contaminant sources using X-Ray Fluorescence (XRF) equipment. Due to field conditions, the instruments exceeded operating temperatures on several occasions. It was determined that the equipment was not able to function properly in a high temperature environment and its use was discontinued. A memo presenting the results of the limited XRF screening conducted is included in Appendix D.

Section 2 of this document includes a discussion of the area and regional characteristics. Section 3 provides a description of the PA and SI field activities conducted by the START-2 E & E and Weston in coordination with Washington State Department of Ecology (Ecology), United States Bureau of Land Management (BLM), and the United States Forest Service (USFS) staff. Quality assurance/quality

control (QA/QC) criteria are included in Section 4. Reporting criteria, reporting methods, and background sample analytical results are discussed in Section 5. Mine and mill locations, descriptions, and START-2 visits are discussed in Section 6. Section 7 provides a discussion of the potential sources, surface water migration pathways, targets, and corresponding EPA Contract Laboratory Program (CLP) and subcontracted laboratory sampling results. PA and SI findings and recommendations are summarized in Section 8. Photographic documentation are provided in Appendix A. Global positioning system (GPS) coordinates are provided in Appendix B. Copies of the START-2 logbooks are provided in Appendix C. Data quality assurance review memorandums and analytical data forms are provided in Appendix D. The data for the samples collected at Myers Dam and the Metaline Falls municipal water intake are provided in Appendices E and F, respectively. The trip report prepared by Weston is provided in Appendix G.

Table 1-1

MINES AND MILLS
LOWER PEND OREILLE RIVER MINES AND MILLS PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

Mine/Mill Name	Mine/Mill	LAT			LONG			S	T	R	River System(s)
Sterling	Mine	48	50	10.32	117	23	29.04	32	39N	43E	Overland (1,700 ft), Pend Oreille River at River Mile 29.
Metaline	Mine	48	50	32.64	117	23	24.00	32	39N	43E	Overland (1,700 ft), Pend Oreille River at River Mile 29.
Blue Bucket	Mine	48	50	37.68	117	23	53.52	32	39N	43E	Overland (1,700 ft), Pend Oreille River at River Mile 29.
Bella May	Mine	48	50	53.16	117	24	16.20	29	39N	43E	Unnamed Creek, through Metaline, Pend Oreille River at River Mile 29.
Diamond R.	Mine	48	51	12.60	117	25	19.20	30	39N	43E	Unnamed Creek, through Metaline, Pend Oreille River at River Mile 29.
Lehigh No. 1	Mine	48	51	02.52	117	24	14.04	29	39N	43E	Unnamed Creek, through Metaline, Pend Oreille River at River Mile 29.
West Contact	Mine	48	51	07.92	117	24	56.88	30	39N	43E	Linton Creek, Pend Oreille River at River Mile 29.25.
Lehigh No. 2	Mine	48	51	31.68	117	24	52.20	30	39N	43E	Linton Creek, Pend Oreille River at River Mile 29.25.
Oriole	Mine	48	51	36.72	117	24	46.44	19	39N	43E	Linton Creek, Pend Oreille River at River Mile 29.25.
Josephine	Mine	48	52	48.00	117	22	15.96	16	39N	43E	Overland, Pend Oreille River (9 miles south fo Boundary Dam).
Grandview	Mine/Mill	48	52	22.04	117	21	26.16	14,15,22,30	39N	43E	Overland, Pend Oreille River (9 miles south fo Boundary Dam).
Pend Oreille	Mine/Mill	48	52	54.12	117	21	36.00	10,11,14,15	39N	43E	Overland, Pend Oreille River (9 miles south fo Boundary Dam).
Yellowhead	Mine	48	52	59.88	117	22	14.16	16	39N	43E	Overland (1,000 ft), Pend Oreille River (8 miles south of Boundary Dam).
Hoage	Mine	48	56	57.48	117	21	18.00	22	40N	43E	Upper Lead King Lake, Lower Lead King Lake, Everett Creek
Lucky Strike	Mine	48	55	49.80	117	19	51.24	35	40N	43E	Overland (800 ft), Pend Oreille River (4 miles south of Boundary Dam).
Lead King	Mine	48	56	16.44	117	21	13.32	27	40N	43E	Lower Lead King Lake, Everett Creek
Z Canyon	Mine							11	40N	43E	Overland (1,400 ft), Pend Oreille River (2,500 ft north of Boundary Dam).
Lead Queen	Mine							11	40N	43E	Overland (1 mile), Pend Oreille River (1,000 ft north of Boundary Dam).
Lead Hill	Mine	48	58	12.72	117	11	49.56	11, 12, 13, 14, 22, 23, 27	40N	44E	Slate Creek , Pend Oreille River (5 miles south of Boundary Dam).
King Tut	Mine							2,11	40N	44E	Overland, Unnamed Tributary, Canada
Red Top	Mine							1,2	40N	44E	Overland, Lead Creek, Canada

Key:

E	= East.
ft	= feet.
Lat	= Latitude.
Long	= Longitude.
N	= North.
R	= Range.
S	= Section.
T	= Township.

2. BACKGROUND

2.1 REGIONAL CHARACTERISTICS AND DESCRIPTIONS

The lower reach of the Pend Oreille River (as defined in Section 1) is located in Pend Oreille County, Washington. Pend Oreille County is located in the northeast corner of Washington State. Bordered on the north by Canada, the east by Idaho, the south by Spokane County, and the west by Stevens County. Pend Oreille County is roughly 66 miles long and 22 miles wide. Within the county, the Pend Oreille River, the second largest river in Washington, flows north into Canada (Pend Oreille County 2001).

The Clark-Fork/Pend Oreille Basin system flows from Montana as the Clark Fork River into Lake Pend Oreille in Idaho (Figure 2-1). The Pend Oreille River, originating as the outflow from Lake Pend Oreille, enters Washington flowing north through the northeast corner of the state into Canada, where it drains to the Columbia River just above the International Border (Figures 2-1 and 2-2; Ecology 1991). The Columbia River in Canada flows south into Washington State. The Clark-Fork/Pend Oreille Watershed covers approximately 26,000 square miles in Montana, Idaho, and Washington (USGS 2000).

The area, as defined for this project, includes: 21 mine/mill facilities identified as potential sources of contaminants, and tributaries (e.g., creeks and streams) near these facilities that empty into the lower reach (as defined in Section 1) of the Pend Oreille River (Tables 1-1 and 2-1).

2.2 OWNERSHIP INFORMATION

The majority of lands in the upper reaches of the project area are federal lands managed by BLM and the USFS. Privately held or leased lands are scattered throughout the project area. Livestock grazing occurs on privately held lands and through grazing leases on publicly held lands.

Much of the river basin's land within Pend Oreille County falls within the boundaries of the Kaniksu and Colville national forests. Two-thirds of the northern and central parts of the county are government owned; the southern portion of the study area is mostly privately owned. (EPA 1993) Owners/contact persons for the mines/mills visited are included in Section 6. Owners of properties associated with tributaries that were visited as part of this field event are identified in Table 2-1.

2.3 REGIONAL OPERATIONS AND WASTE CHARACTERISTICS

2.3.1 Historic Mining

The Metaline mining district surrounding the town of Metaline in Pend Oreille County is one of the oldest in the state, predating statehood. Mining in the vicinity of the Pend Oreille River dates back to 1855 (Barlee 1932). Commercial development of the Metaline district can be traced to Lewis P. Larsen and Jens Jensen. During 1904, they began prospecting the area around Metaline Falls and initiated development of the Lehigh Cement Co. Plant and quarries. This was followed by the opening of several lead-zinc mines. (Barlee 1932)

The north and south ends of the county proved to contain some of the richest deposits of lead and zinc in the Pacific Northwest. However, through the turn of the century, the Metaline area languished in virtual isolation. Access was limited to steamers plying the Pend Oreille River from Newport to only as far downstream as south Ione. In 1906, the channel at Box Canyon was dynamited making the river navigable all the way downstream to Metaline Falls. This cleared the way for commercial drilling and mining, which expanded rapidly through the 1930s. Large quantities of another mineral, limestone, was discovered and comprised the backbone of the country's cement industry, at that time the largest in the state. (Economic History 2001)

The lead-zinc ores of the Metaline district are of low grade and contain only minor amounts of silver. The average grade of the 19.3 million tons of ore mined from 1906 to 1977 in the district was 1.14 percent lead and 2.25 percent zinc (Lasmanis 1995).

Historically, metal extraction and processing were relatively inefficient, yielding large volumes of metal-rich tailings that were deposited in and near nearby streams (USGS 2000). Mine tailings in the study area typically contain elevated levels of arsenic, cadmium, copper, lead, mercury, and zinc. These tailings and mines continue to provide a source of metals to streams, lakes, and reservoirs as surface water meanders through and erodes tailings deposits and transports these metals downstream or directly to the Pend Oreille River. (USGS 2000)

In 1963, the Metaline mining district was the 12th largest lead and zinc producer in the Nation (USDA 1992).

Table 2-1

TRIBUTARY OWNERS
LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

Tributary	County	Owner	Contact Information
Pewee Creek	Pend Oreille County, WA	Seattle City Light	Harris Martin Seattle City Light 700 Fifth Avenue, Suite 3300 Seattle, WA 98104-5031 (206) 386-4577
Everett Creek	Pend Oreille County, WA	Seattle City Light	Harris Martin Seattle City Light 700 Fifth Avenue, Suite 3300 Seattle, WA 98104-5031 (206) 386-4577
Sullivan Creek	Pend Oreille County, WA	Lafarge Corp.	David Carroll Lafarge Corp. 12950 Worldgate Drive, Suite 500 Herndon, VA
Lime Creek	Pend Oreille County, WA	U.S. Forest Service	U.S. Forest Service 765 South Main Colville, WA 99114 (509) 684-7000
Ledbetter Lake Creek	Pend Oreille County, WA	U.S., public land	
Slate Creek	Pend Oreille County, WA	U.S. Forest Service	U.S. Forest Service 765 South Main Colville, WA 99114 (509) 684-7000
Beaver Creek	Pend Oreille County, WA	U.S., public land	
Flume Creek	Pend Oreille County, WA	Bureau of Land Management	Bureau of Land Management 1515 SW Fifth Avenue Portland, OR 97201
Linton creek	Pend Oreille County, WA	City of Metaline	Kelly Curtiss Town of Metaline P.O. Box 33 Metaline, WA 99152

3. FIELD ACTIVITIES AND ANALYTICAL PROTOCOL

A SQAP for the Lower Pend Oreille River Mines and Mills PAs and SIs activities was developed by the START-2 prior to performing the field sampling (E & E 2001a). The SQAP was based on background information collected by E & E. The SQAP describes the sampling strategy, sampling methodology, and analytical program to identify potential hazardous substance source areas and impacts to potential targets. With few exceptions, field activities were conducted in accordance with the approved SQAP. Deviations from the SQAP are described when applicable. Field activities were conducted in coordination with BLM, USFS, and Ecology staff.

The field event was conducted from June 17 to 30, 2001. Sampling was conducted at 5 of the 21 mines/mills visited. Sampling was conducted at those mines/mills where potential sources of contamination were identified and where possible impacts to receptors via the surface water migration pathway were observed. Possible receptors of contamination that were identified were also sampled.

As described in the SQAP, potential contaminant sources include tailings piles/ponds, waste rock piles, adits, and stained soil areas surrounding improperly stored or disposed drums and containers. Potential receptors/targets may include wetland areas, fisheries, surface water intakes, sensitive environments, etc. as defined in the EPA Harzard Ranking System (HRS); Final Rule. The contaminants of concern are Target Analyte List (TAL) metals, pesticides/polychlorinated biphenyls (pesticides/PCBs), and semivolatile organic compounds (SVOCs). Total organic carbon (TOC) data was also collected.

A total of 48 soil/sediment samples and 16 surface water samples were collected and analyzed under the EPA CLP for TAL metals. A portion, 34 sediment samples were also analyzed under the EPA CLP for pesticides/PCBs. One sediment sample was analyzed for SVOCs. A total of 34 sediment samples were submitted to a commercial laboratory for TOC analysis.

Sample types and the methods of collection are described below. A list of all samples collected for laboratory analysis under the PA and SI activities are contained in Table 3-1 at the end of this section. A discussion of sample results is contained in Sections 6 and 7. Photographic documentation of the PA and SI field activities are contained in Appendix A.

Information pertinent to Weston's related sampling activities involving the collection of mine/mill-specific background samples is included in Appendix G.

3.1 SAMPLING METHODOLOGY

Sampling for surface soil, surface water, and sediment followed the standard operating procedures contained in Appendix A of the SQAP (E & E 2001a). Grass, leaves and other vegetative material, rocks and other debris unsuitable for analysis were removed from soil samples before being placed into the sampling containers. Surface soil and sediment samples were homogenized in dedicated plastic bowls (except for pesticides/PCB analysis) prior to containerization in sample jars. Dedicated plastic spoons and scoops were used to extract, homogenize, and place sample material into sample containers (except for pesticides/PCB analysis). Dedicated steel bowls and steel spoons were used for the collection and homogenization of pesticides/PCB samples.

Water samples were collected by hand-dipping a 1-liter poly bottle sample container into the water at well-mixed locations within the stream, or by using an unused sample container as a scoop to obtain water samples in areas of low flow. An aliquot of each sample was tested in the field for temperature and pH. After preservation, pH was checked again to ensure that the appropriate pH level had been achieved.

All samples were stored on ice in coolers continuously maintained under chain of custody. Vehicles were locked if the sampling team had to walk out of visual range of the 4 x 4 vehicles. Sample coolers from all teams were moved into a single occupied location (motel room) each evening to ensure custody control and to re-ice as needed.

3.1.1 EPA CLP Surface Soil Samples

A total of 14 surface soil samples, including two background samples, were collected. Soil samples were discrete grab samples collected from potential source and background areas. Surface soil samples were collected from 0 to 6 inches below ground surface (bgs). Samples were analyzed for TAL metals.

3.1.2 EPA CLP Sediment Samples

Sediment samples were collected as outlined in the text of the SQAP (E & E 2001a). Sediment samples were collected from below the apparent water line from 0 to 8 inches below the sediment surface in order from most downstream locations to most upstream locations. Samples were analyzed for TAL

metals, pesticides/PCBs, and TOC. MDSB01SD was additionally analyzed for SVOCs due to its location downstream of a wood treatment facility.

3.1.3 EPA CLP Surface Water Samples

Surface water samples were collected prior to collecting co-located sediment samples and from the most downstream locations to the most upstream locations. Water samples were analyzed for TAL metals.

3.2 ANALYTICAL PROTOCOLS

All samples collected were shipped off-site for chemical analysis, with the exception of field measurement for pH. Analytical methods applied to E & E samples consisted of: EPA CLP TAL metals, EPA CLP pesticides/PCBs, EPA CLP SVOCs, and EPA SW-846 TOC. These analyses were applied to samples collected from suspected sources or targets in varying combinations based on the SQAP. Laboratories performing the analyses were Sentinel, Inc., in Huntsville, Alabama (EPA CLP TAL metals); Envirosystems Inc., in Columbia, Maryland (EPA CLP pesticides/PCBs and EPA CLP SVOCs); and Analytical Services Center, E & E, Lancaster, New York (EPA SW-846 TOC). Analytical methods applied to mine/mill-specific background samples collected by Weston are noted in Section 4.

3.3 GLOBAL POSITIONING SYSTEM

Trimble™ Pathfinder Professional XL GPS survey units and data loggers were used by the START-2 to approximate the horizontal location coordinates of sample points. Except as noted for specific sample locations, the units provided three dimensional differentially corrected sample coordinates with ± 1 meter accuracy. Due to the combination of the mountainous terrain and limited satellite coverage over this area, the GPS units were often operating in no more than two dimensional mode.

Sample coordinates were plotted onto a digitized map and then incorporated into Geographic Information System databases to develop a station/sample location map. The START-2 was not able to obtain accurate GPS coordinates at some locations due to mountainous terrain. These station locations were estimated on the sample location map based on field observations. GPS coordinates by sample point are provided in Appendix B. Weston GPS coordinates are found in Appendix G.

3.4 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) generated during the sampling effort consisted of used personal protective clothing and disposable sampling equipment. IDW was disposed of as non-hazardous solid waste at a municipal landfill. No IDW generated by the START-2 remains in the project area.

Table 3-1

SAMPLE COLLECTION AND ANALYTICAL SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	E & E Sample ID	Station Location ID	CLP Organic No.	CLP Inorganic No.	Matrix	Depth	Sampler	Date	Time	TAL Metals	Pesticdes/ PCBs	TOC	SVOCs	Sample Description
Blue Bucket Mine														
01264268	NU	BBPP01SW	NU	MJ0F13	SW	-	AJ	06/26/01	13:00	X				Clear water, no odor.
01264267	01050280	BBPP01SD	J0F16	MJ0F16	SD	0-6	AJ	06/26/01	13:00	X	X	X		Very sandy, multicolored.
01264270	NU	BBPP02SW	NU	MJ0F15	SW	-	AJ	06/26/01	13:05	X				Clear water, no odor.
01264269	01050279	BBPP02SD	J0F14	MJ0F14	SD	0-6	AJ	06/26/01	13:05	X	X	X		Gray and dark brown, fine-grained.
Joesphine Mine														
01264356	NU	JOSP01SW	NU	MJ0FK9	SW	-	TK	06/26/01	15:10	X				Clear, no odor.
01264423	01050247	JOPP01SD	J0GN2	MJ0GN2	SD	0-8	RN	06/28/01	09:35	X	X	X		Gray, fine to coarse sand and fine gravel.
Oriole Mine														
01264271	NU	ORSP01SW	NU	MJ0F17	SW	-	NA	06/27/01	12:35	X				Clear, no odor.
01264272	01050274	ORSP01SD	J0F18	MJ0F18	SD	0-8	NA	06/27/01	12:40	X	X	X		Light gray to light brown, sand to coarse gravel.
01264273	01050273	ORSP02SD	J0F19	MJ0F19	SD	0-8	NA	06/27/01	14:05	X	X	X		Brown, moist fine sand.
Pend Oreille Mine/Mill														
01264266	NU	POCK01SW	NU	MJ0F11	SW	-	AJ	06/25/01	16:20	X				Clear water, no odor.
01264263	01050277	POCK01SD	J0F08	MJ0F08	SD	0-8	AJ	06/25/01	16:28	X	X	X		Dark, sandy material.
01264401	NU	POPP01SW	NU	MJ0GL0	SW	-	CG	06/25/01	08:45	X				Clear water, no odor, warm.
01264410	NU	POPP02SW	NU	MJ0GL9	SW	-	DW	06/26/01	13:35	X				Clear, no odor, cold.
01264411	01050239	POPP02SD	J0GM0	MJ0GM0	SD	0-8	DW	06/26/01	13:40	X	X	X		Brown fine to medium sand (80-90%), fines (10-20%).
01264412	NU	POPP03SW	NU	MJ0GM1	SW	-	DW	06/26/01	14:20	X				Clear water, no odor, cold.
01264413	01050240	POPP03SD	J0GM2	MJ0GM2	SD	0-8	DW	06/26/01	14:25	X	X	X		Brown fine to medium sand, trace gravel.
01264351	01050260	POSP01SD	J0FK4	MJ0FK4	SD	0-8	TK	06/26/01	09:11	X	X	X		Dark gray, lots of very fine clay.
01264352	01050261	POSP02SD	J0FK5	MJ0FK5	SD	0-8	TK	06/26/01	09:35	X	X	X		Gray, almost all clay.
01264252	NU	POTP01SS	NU	MJ0EZ7	SS	0-6	AJ	06/25/01	09:35	X				Moist, gray, clayey with rocks.
01264253	NU	POTP02SS	NU	MJ0EZ8	SS	0-6	AJ	06/25/01	10:25	X				Moist brown/dark brown, medium soil.
01264254	NU	POTP03SS	NU	MJ0EZ9	SS	0-6	AJ	06/25/01	10:45	X				Brown and light brown, sandy, slightly moist.
01264255	NU	POTP04SS	NU	MJ0F00	SS	0-6	AJ	06/25/01	11:25	X				Mixture of sand and tailings, white and brown, dry.
01264256	NU	POTP05SS	NU	MJ0F01	SS	0-6	AJ	06/25/01	11:45	X				Mixture of sand and tailings, white and dark brown, dry.
01264257	NU	POTP06SS	NU	MJ0F02	SS	0-6	AJ	06/25/01	12:00	X				Brown/dark brown, slightly moist, with rocks and organic matter.

Table 3-1

SAMPLE COLLECTION AND ANALYTICAL SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	E & E Sample ID	Station Location ID	CLP Organic No.	CLP Inorganic No.	Matrix	Depth	Sampler	Date	Time	TAL Metals	Pesticdes/ PCBs	TOC	SVOCs	Sample Description
01264258	NU	POTP07SS	NU	MJ0F03	SS	0-6	AJ	06/25/01	14:05	X				Brown, fine, mixture of tailings and soil (gray and white), dry.
01264259	NU	POTP08SS	NU	MJ0F04	SS	0-6	AJ	06/25/01	14:12	X				Fine gray and brown sand and tailings.
01264260	NU	POTP09SS	NU	MJ0F05	SS	0-6	AJ	06/25/01	14:22	X				Brown and gray.
01264353	NU	POWP01SS	NU	MJ0FK6	SS	0-6	TK	06/26/01	10:20	X				Dark gray, lots of rocks, very coarse sand to gravel.
01264354	NU	POWP02SS	NU	MJ0FK7	SS	0-6	TK	06/26/01	10:35	X				Gray, lots of rocks, very coarse sand to gravel.
01264355	NU	POWP03SS	NU	MJ0FK8	SS	0-6	TK	06/26/01	10:45	X				Brown and gray, lots of rocks, very coarse sand to gravel.
01264264	01050278	TCBK01SD	J0F09	MJ0F09	SD	0-8	AJ	06/25/01	15:50	X	X	X		Large beige sandy material with larger black rocks.
01264265	NU	TCBK01SW	NU	MJ0F10	SW	-	AJ	06/25/01	15:55	X				Clear water, no odor.
Pend Oreille River														
01264402	01050231	PRRS01SD	J0GL1	MJ0GL1	SD	0-8	DW	06/25/01	11:00	X	X	X		Medium brown, moderate to very fine sand 80%, silt and clay 20%.
01264404	01050233	PRRS02SD	J0GL3	MJ0GL3	SD	0-8	DW	06/25/01	12:30	X	X	X		Medium brown, moderate to very fine sand 80-90%, silt and clay 10-20%.
01264409	01050238	PRRS03SD	J0GL8	MJ0GL8	SD	0-8	DW	06/26/01	11:40	X	X	X		Brown, fine sand 70-80%, fines 20-30%.
01264414	01050241	PRRS04SD	J0GM3	MJ0GM3	SD	0-8	DW	06/27/01	11:45	X	X	X		Dark brown, silt and clay 70-80%,sand 20-30%, sulfur odor.
01264403	01050232	PRTB01SD	J0GL2	MJ0GL2	SD	0-8	DW	06/25/01	12:00	X	X	X		Light gray to brown silt and clay 60-70%, fine sand 30-40%.
01264405	01050234	PRTB02SD	J0GL4	MJ0GL4	SD	0-8	DW	06/25/01	13:45	X	X	X		Dark brown, fine sand 80%, fines 20%.
01264406	01050235	PRTB03SD	J0GL5	MJ0GL5	SD	0-8	DW	06/25/01	14:15	X	X	X		Dark brown, silt and clay 70%, sand 30%.
01264407	01050236	PRTB04SD	J0GL6	MJ0GL6	SD	0-8	DW	06/26/01	10:10	X	X	X		Light gray to brown, silt and clay 60%, fine sand 30-40%.
01264408	01050237	PRTB05SD	J0GL7	MJ0GL7	SD	0-8	DW	06/26/01	10:45	X	X	X		Gray to black fine to coarse sand.
01264421	01050245	PRTB06SD	J0GN0	MJ0GN0	SD	0-8	DW	06/27/01	17:15	X	X	X		Brown, fine to medium sand 80-90%, fines 10-20%.
01264422	01050246	PRTB07SD	J0GN1	MJ0GN1	SD	0-8	DW	06/27/01	18:05	X	X	X		Dark to medium brown, fine to medium sand 70%, clay 30%.
01264424	01050248	PRTB08SD	J0GN3	MJ0GN3	SD	0-8	RN	06/28/01	12:35	X	X	X		Brown, fine to coarse sand and trace fine gravel 90-100%.
01264425	01050249	PRTB09SD	J0GN4	MJ0GN4	SD	0-8	RN	06/28/01	13:10	X	X	X		Brown, fine to medium and, trace gravel 95%, trace fines 0-5%.

Table 3-1

SAMPLE COLLECTION AND ANALYTICAL SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	E & E Sample ID	Station Location ID	CLP Organic No.	CLP Inorganic No.	Matrix	Depth	Sampler	Date	Time	TAL Metals	Pesticdes/ PCBs	TOC	SVOCs	Sample Description
Metaline Falls Municipal Water Intake														
01264429	NU	MF01SW	NU	MJ0GN8	SW	0	LD	06/28/01	11:50	X				Clear, no odor, 64 gallons per minute.
01264430	NU	MF02SW	NU	MJ0GN9	SW	0	LD	06/28/01	12:00	X				Clear, no odor, 48 gallons per minute.
Grandview Mine/Mill*														
01264415	NU	GMPP04SW	NU	MJ0GM4	SW	0	DW	06/27/01	12:05	X				Clear, no odor, cold.
01264416	01050242	GMPP04SD	J0GM5	MJ0GM5	SD	0-8	DW	06/27/01	12:10	X	X	X		Gray, multicolored, sand medium to very fine 95-100%, fines 0-5%.
01264417	NU	GMPP05SW	NU	MJ0GM6	SW	0	DW	06/27/01	12:30	X				Clear, no odor, cold.
01264418	01050243	GMPP05SD	J0GM7	MJ0GM7	SD	0-8	DW	06/27/01	12:35	X	X	X		Medium brown, silt and clay 60-70%, fine to very fine sand 30-40%.
Background Samples														
01264358	NU	BK02SS	NU	MJ0FL1	SS	0-6	AJ	06/27/01	10:40	X				Dark brown, clay-loam, 10% or less sand.
01264274	NU	BK03SS	NU	MJ0F20	SS	0-6	NA	06/27/01	13:30	X				Dark brown, slightly moist, some organic matter.
01264419	NU	POBK01SW	NU	MJ0GM8	SW	0	DW	06/27/01	12:55	X				Dark brown, slightly moist, some organic matter.
01264420	01050244	POBK01SD	J0GM9	MJ0GM9	SD	0-8	DW	06/27/01	13:00	X	X	X		Brown clay and silt 60-70%, sand 30-40%.
01264426	01050250	PRBK01SD	J0GN5	MJ0GN5	SD	0-8	RN	06/28/01	13:55	X	X	X		Brown fine to medium sand 90%, trace fines 0-10%.
01264427	01050251	PRBK02SD	J0GN6	MJ0GN6	SD	0-8	RN	06/28/01	14:05	X	X	X		Brown silt and clay 70-80%, fine to very fine sand 20-30%.
01264428	01050252	PRBK03SD	J0GN7	MJ0GN7	SD	0-8	RN	06/28/01	14:15	X	X	X		Brown fine to very fine sand 70-80%, clay and silt 20-30%.
Meyers Dam														
01374222	01090441	MDSB01SD	J0KK8	MJ0KK8	SD		MT	09/12/01	09:38	X	X	X	X	Gray sandy silt.

Table 3-1

SAMPLE COLLECTION AND ANALYTICAL SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	E & E Sample ID	Station Location ID	CLP Organic No.	CLP Inorganic No.	Matrix	Depth	Sampler	Date	Time	TAL Metals	Pesticdes/ PCBs	TOC	SVOCs	Sample Description
Weston Samples														
01264070	NU	US002SD	JX829	MJ0BQ3	SD	0-2	KB	06/28/01	09:30	X	X	X		Brown, fine to coarse sand, silt and clay, no odor.
01264067	NU	UW002SW	NU	MJ0BQ0	SW	0	KB	06/28/01	09:45	X				No description provided.
01264073	NU	US003SD	JX831	MJ0BQ5	SD	0-4	KB	06/28/01	10:45	X	X	X		Gray/brown, fine to coarse sand, some silt, no odor.
01264074	NU	UW003SW	NU	MJ0BQ6	SW	0	KB	06/28/01	10:55	X				No description provided.
01264075	NU	US004SD	JX832	MJ0BQ7	SD	0-2	KB	06/28/01	13:00	X	X	X		Dark brown, fine sand to coarse gravel, some silt, no odor.

* Samples were also collected during the Grandview Mine Site Inspection. A complete description of this site inspection can be requested from the EPA.

Key:

AJ = Al Johnson.
BB = Blue Bucket Mine.
BK = background sample.
CG = Charles Gregory.
CK = Creek 1.
CLP = Contract Laboratory Program.
DW = Dan Weiss.
E & E = Ecology & Environment, Inc.
EPA = United States Environmental Protection Agency.
GM = Grandview Mine.
ID = Identificiation.
JO = Josephine Mine.
KB = Kevin Brown.
LD = Leatta Dahlhoff.
MF = Metaline Falls municipal water intake.
MT = Monica Tonel.
NA = Neil Amick.
No. = Number.
NU = Not utilized.
OR = Oriole Mine.
PCBs = Polychlorinated biphenyls.
PO = Pend Oreille Mine.
PPE = probable point of entry.
PR = Pend Oreille River.
RN = Renee Nordeen.
RS = river sediment.
SD = sediment.
SP = spring.
SS = surface soil.
SVOCs = Semivolatile Organic Compounds.
SW = surface water.
TAL = Target Analyte List.
TB = tributary.
TC = Threemile Creek.
TK = Tara Karamas.
TOC = Total Organic Compound.
TP = tailings pile.
US = Tributary sediment/soil (upstream/upland sampling location).
UW = Upland surface water.
Weston = Roy F. Weston, Inc.
WP = waste rock pile.

4. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of sampling equipment, glassware, and reagents. Specific QC requirements for laboratory analyses are incorporated in the *Contract Laboratory Program Statement of Work for Organic Analyses* (EPA 1999) and in the *Contract Laboratory Program Statement of Work for Inorganic Analyses* (EPA 2000a). These QC requirements or equivalent requirements were followed for analytical work on the Lower Pend Oreille River project. This section describes the QA/QC measures taken and provides an evaluation of the usability of data presented in this report.

Some of the field work for this project was performed in conjunction with Weston. Unless otherwise noted, QA/QC information applies to all samples collected for the project. All samples were collected following the guidance of the SQAPs (E & E 2001a; Weston 2001) for the field activities. E & E soil and water inorganic analyses were performed at Sentinel, Inc., Huntsville, Alabama, a CLP laboratory, following the *CLP Statement of Work for Inorganic Analyses* (EPA 2000a). Weston soil and water inorganic analyses were performed at Datachem Laboratories, Inc., Salt Lake City, Utah, and Sentinel, Inc., Huntsville, Alabama, CLP laboratories, following the *CLP Statement of Work for Inorganic Analyses* (EPA 2000a). E & E soil and water organic analyses were performed at Envirosystems, Inc., Columbia, Maryland, a CLP laboratory, following the *CLP Statement of Work for Organic Analyses* (EPA 1999). Weston soil organic analyses were performed by the Mitkem Corporation, Warwick, Rhode Island, and Laucks Testing Laboratory, Seattle, Washington, CLP laboratories, following the *CLP Statement of Work for Organic Analyses* (EPA 1999). E & E TOC analyses were performed at the Ecology and Environment, Inc. Analytical Services Center, Lancaster, New York, a START-2 subcontracted commercial laboratory, following the Lloyd Kahn Method. Weston TOC analyses were performed by North Creek Analytical Laboratory, Inc., Bothell, Washington, a subcontracted commercial laboratory, following modified EPA Method 9060.

All data from analyses performed by the CLP laboratories were reviewed and validated by EPA and/or Environmental Services Assistance Team chemists. Data from the subcontracted commercial laboratories were reviewed and validated by E & E and/or Weston chemists. Data qualifiers were applied as necessary according to the following guidance:

- *EPA* (1994a) *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review;* and
- *EPA* (1999) *Contract Laboratory Program National Functional Guidelines for Organic Data Review.*

In the absence of other QC guidance, method-specific QC limits were also utilized to apply qualifiers to the data. Copies of the data QA memoranda are included in Appendix D.

4.1 SATISFACTION OF DATA QUALITY OBJECTIVES

The following EPA (1994b) guidance document was used to establish data quality objectives (DQOs) for this project:

- *Guidance for the Data Quality Objectives Process,* EPA /600/R-96/055.

The EPA Task Monitor (TM) determined that definitive data without error and bias determination would be used for the sampling and analyses conducted during the field activities. The data quality achieved during the field work produced sufficient data that meet the data objectives stated in the SQAPs (E & E 2001a; Weston 2001).

A detailed discussion of the project data quality objectives that were accomplished is presented in the following sections.

4.2 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA samples (rinsate blanks and trip blanks) were not required for this project. Trip blank samples are only required for volatile organic compound samples, which were not collected for this project. Rinsate blank samples are required for non-dedicated sampling equipment; all sampling equipment for this project was dedicated, therefore rinsate blank samples were not collected. QC samples included matrix spike/matrix spike duplicate (MS/MSD) samples for organic analyses or MS/duplicate samples for inorganic analyses at a rate of one MS/MSD or one MS/duplicate per 20 samples per matrix, excluding QA samples; these QC analyses are not applicable for QA samples. Temperature blanks were included in each sample cooler to ensure that temperature requirements were

met. Some of the Weston TOC samples were received at temperatures greater than that specified in the method; no action was taken based on these discrepancies.

4.3 PROJECT-SPECIFIC DATA QUALITY OBJECTIVES

The laboratory data were reviewed to ensure that DQOs for the project were met. The following describes the laboratories' abilities to meet project DQOs for precision, accuracy, and completeness and the field team's ability to meet project DQOs for representativeness and comparability. The laboratories and the field team were able to meet DQOs for the project.

4.3.1 Precision

Precision measures the reproducibility of the sampling and analytical methodology. Laboratory and field precision is defined as the relative percent difference (RPD) between duplicate sample analyses. The laboratory duplicate samples or MS/MSD samples measure the precision of the analytical method.

The RPD values were reviewed for all laboratory samples. Twenty five sample results (approximately 1.2%) were qualified as estimated quantities (J) based on laboratory duplicate QC outliers. The DQO for precision of 85% was met.

4.3.2 Accuracy

Accuracy measures the reproducibility of the sampling and analytical methodology. Laboratory accuracy is defined as the surrogate spike percent recovery (% R) for each pesticides/PCBs analysis or the MS % Rs for all analyses. The surrogate % R values were reviewed for all appropriate sample analyses. No results were qualified based on surrogate QC outliers.

The MS % R values were reviewed for all MS/MSD analyses. Sixty results (approximately 2.8%) were qualified as estimated quantities (J or UJ) based spike QC outliers. Overall, the project DQOs for accuracy of 85% was met.

4.3.3 Completeness

Data completeness is defined as the percentage of usable data (usable data divided by the total possible data). All laboratory data were reviewed for data validation and usability. None of the data were rejected, therefore the project DQOs for completeness of 90% was met.

4.3.4 Representativeness

Data representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or environmental condition. The number and selection of samples were determined in the field to account accurately for site variations and sample matrices. The DQOs for representativeness of 85% was met.

4.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Data produced for this study followed applicable field sampling techniques and specific analytical methodology. The DQOs for comparability was met.

4.4 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PARAMETERS

The laboratory data also were reviewed for holding times and laboratory blank samples. These QA/QC parameters are summarized below. In general, the QA/QC parameters were considered acceptable.

4.4.1 Holding Times

All samples were analyzed within holding time limits, therefore no results were qualified based on holding time QC outliers.

4.4.2 Laboratory Blanks

All laboratory blanks met the frequency criteria. The following contaminants of concern were detected in the laboratory blanks:

- Pesticides: none;
- SVOCs: bis(2-ethylhexyl)phthalate; and
- TAL Inorganics: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, potassium, sodium, silver, selenium, thallium, and zinc.

Any associated sample result less than five times the positive blank contamination (10 times for common laboratory contaminants) were qualified as not detected (U). Associated sample results less than five times the absolute value of negative inorganic blank contamination were qualified as estimated quantities (J or UJ). A total of 126 inorganic results (approximately 5.9 %) were qualified as not detected (U) or as estimated quantities (J or UJ) based on laboratory blank contamination. See Appendix D for results that were qualified based on blank contamination.

5. ANALYTICAL RESULTS REPORTING AND BACKGROUND SAMPLES

This section describes the reporting criteria and reporting methods applied to EPA CLP analytical results presented in Sections 6 and 7 of this report. A discussion of background sample locations and results also is provided. A list of all samples collected for laboratory analysis is presented in Table 3-1.

5.1 ANALYTICAL RESULTS EVALUATION CRITERIA

Analytical results presented in the summary tables in Sections 6 and 7 show all analytes detected above laboratory detection limits in bold type. Analytical results indicating significant concentrations of contaminants in source samples (Section 6) with respect to background concentrations are shown underlined and in bold type. Similarly, analytical results indicating elevated concentrations of contaminants in target samples (Section 7) with respect to background concentrations also are underlined and in bold type. For the purposes of this investigation, significant/elevated concentrations are defined, using Table 2-3 of the EPA HRS model criteria for observed release (significant or elevated concentrations) as follows.

- Equal to or greater than the sample's contract required quantitation limit/contract required detection limit (CRQL/CRDL) or the sample quantitation limit (SQL) when a non-CLP laboratory was used; and
- Equal to or greater than the background sample's CRQL/CRDL or SQL when the background concentration is below detection limits; or
- At least three times greater than the background concentration when the background concentration equals or exceeds the detection limit.

The analytical summary tables present all detected analytes, but only those detected analytes at potential sources or in targets meeting the significant/elevated concentration criteria are discussed in the report text. All detected concentrations are discussed for background samples, including those concentrations which were qualified as estimated because they were detected below the SQL (JB). Because both tailings and waste rock are unique soil waste matrices placed on surface soil, analytical results of the tailings and waste rock samples collected were compared to the results for background surface soil. The background surface soil samples consisted of native soil.

For analytical results qualified as estimated, the sample concentration was adjusted as described in *Using Qualified Data to Document an Observed Release and Observed Contamination* (EPA 1996) before determination of whether the concentration was significant/elevated. Analytical results are qualified as estimated (flagged "J") when the analyte is positively identified as either present or absent and based on the quality control data provided by the laboratory. The associated numerical value is the approximate concentration of the analyte in the sample. Additional qualifiers were applied when necessary to indicate potential bias of estimated quantities including low, unknown, high, or the result was estimated because it was below the sample quantitation limit:

- B = The detected concentration is below the method reporting limit/CRDL, but is above the instrument detection limit;
- H = The numerical result is likely biased high, above the actual concentration;
- L = The numerical result is likely biased low, below the actual concentration;
- K = The bias of the numerical value is unknown; and
- Q = The detected concentration is below the method reporting limit/CRQL, but is above the method detection limit.

The tables in Section 6 and 7 provide adjusted concentrations (AC) in parenthesis when the adjusted result is elevated with respect to background. For comparison purposes, the CRQL/CRDL is provided in parenthesis for background results that are qualified because they are below the CRQL/CRDL when the analyte is present in target samples at elevated concentrations. When samples were diluted for reanalysis at a laboratory, the dilution results were considered for evaluation and are provided in the tables. For target locations, only those analytes that also were detected in a source at the mine/mill were evaluated to determine whether their concentrations were elevated. All hazardous substances detected using EPA CLP results at target locations and meeting evaluation criteria can be used to document an observed release from the source at the mines/mills to the target.

5.1.1 Sample Results Reporting

When a given analyte was detected at significant/elevated concentrations in four or more samples, the number of samples and the concentration ranges are reported. When an analyte was detected at significant/elevated concentrations in three or fewer samples, the concentration of the analyte in each sample is reported. Analytical results summary tables in each section list detected analytes and concentrations.

Based on EPA Region 10 policy, evaluation of the common earth crust elements aluminum, calcium, iron, magnesium, potassium, and sodium generally is employed only in water mass tracing, which is beyond the scope of this report. For this reason, these elements and results will not be discussed in this report, but are presented in the analytical summary tables.

5.2 BACKGROUND SAMPLES

Background samples were collected for each of the naturally occurring medium from which samples were collected. Those media are surface soil, surface water, and sediment. Background samples were collected for comparison to downstream sample results as defined in Section 5.1. Results for the appropriate background sample(s) appear as the first column(s) in the analytical results summary tables in Sections 6 and 7 for comparison against source or target results.

5.2.1 Background Surface Soil

5.2.1.1 Sample Locations

Two upgradient background locations (BK02SS and BK03SS) were sampled within the project area. Sample locations are listed in Table 3-1. BK02SS was located north of the Circle Motel in Metaline Falls and was upgradient of any mining activity and reflects background concentrations for surface soil samples collected at mines/mills located on the east side of the Pend Oreille River in the project area (Figure 7-1). BK03SS was located approximately 650 feet northwest from the adit/shaft at the Oriole Mine and upgradient of any mining activity and reflects background concentrations for surface soil samples collected at mines/mills located on the west side of the Pend Oreille River in the project area (Figures 6-4 and 7-1).

The surface soil samples were collected from 0 to 6 inches bgs. The matrix of the samples appeared similar to that of the native soil observed at the mines/mills.

To determine if analyte concentrations are significant/elevated, source/target sample data were compared to the highest background concentrations for each analyte.

In this report, background concentrations of TAL metals (pesticides/PCBs, TOC, and SVOCs where applicable) will be compared to source and target sample concentrations, as described in sections 6 and 7, which have been analyzed by the same method (i.e., CLP).

5.2.1.2 Sample Results

Nine TAL metals were detected, ranging from a concentration of 3.5 milligrams per kilogram (mg/kg) arsenic to 989 mg/kg manganese in sample BK02SS (Table 6-7). Nine TAL metals were

detected, ranging from a concentration of 6.7 mg/kg arsenic to 4,050 mg/kg manganese in sample BK03SS (Table 6-7).

5.2.2 Background Surface Water

5.2.2.1 Sample Locations

Two upgradient background locations (TCBK01SW and POBK01SW) were sampled within the project area. Sample locations are listed in Table 3-1. TCBK01SW was located on Threemile Creek upgradient of any mining activity and reflects background concentrations for Creek 1 sampled at the Pend Oreille Mine/Mill (Figure 6-12).

POBK01SW was located on the Pend Oreille River upgradient of the Josephine Mine, Grandview Mine/Mill, and Pend Oreille Mine/Mill and reflects background concentrations for the Pend Oreille River, Josephine Mine, Grandview Mine/Mill, and Pend Oreille Mine/Mill (Figure 6-12).

To determine if analyte concentrations are significant/elevated, source/target sample data were compared to the background concentrations for each analyte.

5.2.2.2 Sample Results

No TAL metals were detected in TCBK01SW (Table 7-3). No TAL metals were detected in POBK01SW (Tables 6-3, 6-5, and 6-8).

5.2.3 Background Sediment

5.2.3.1 Sample Locations

Six upgradient background locations (PRBK01SD, PRBK02SD, PRBK03SD, TCBK01SD, POBK01SD, and US004SD) were sampled within the project area. Sample locations are listed in Table 3-1.

TCBK01SD was located on Threemile Creek upgradient of mining activity and reflects background concentrations for Creek 1 sampled at the Pend Oreille Mine/Mill (Figure 6-12). The sample location was co-located with TCBK01SW.

POBK01SD was located on the Pend Oreille River upgradient of the Josephine Mine, Grandview Mine/Mill, and Pend Oreille Mine/Mill and reflects background concentrations for the Pend Oreille River, Josephine Mine, Grandview Mine/Mill, and Pend Oreille Mine/Mill (Figure 6-12). The sample location was co-located with POBK01SW.

US004 was located on Linton Creek upgradient of the Oriole Mine and reflects background concentrations for Oriole and Blue Bucket mines (Figure 7-1).

To determine if analyte concentrations are significant/elevated, source/target sample data were compared to the background concentrations for each analyte.

5.2.3.2 Sample Results

Six TAL metals were detected, ranging from a concentration of 5.7 mg/kg chromium to 211 mg/kg manganese in sample TCBK01SD (Table 7-4). Nine TAL metals were detected, ranging from a concentration of 16.3 mg/kg arsenic to 921 mg/kg manganese in sample POBK01SD (Tables 6-4, 6-6, and 6-9). Eight TAL metals were detected, ranging from a concentration of 2.6 mg/kg arsenic to 699 mg/kg manganese in sample US004SD (Tables 6-1 and 6-2).

6. MINES AND MILLS, LOCATIONS/DESCRIPTIONS, START-2 VISITS

This section identifies the mines and mills visited by EPA and the START-2 personnel as part of this field event. The mines/mills are presented in order of location relative to the Pend Oreille River and its tributaries, beginning with those mines/mills located in Metaline, continuing downstream along the river to Boundary Dam near the International Border. Mine/mill location, historical information, description, and ownership information are presented for each mine/mill. This section also presents field observations for the START-2 contractor and/or EPA personnel during the visits. For the five mines and mills where sampling was conducted, analytical results are presented in this section (Figures 6-1 through 6-12).

6.1 STERLING MINE

6.1.1 Mine Location

Latitude:	48° 50' 10.32"N
Longitude:	117° 23' 29.04"W
Legal Description:	E½ Section 32, Township 39N, Range 43E
CERCLIS ID:	WAN001002331
County:	Pend Oreille
Contact:	Bureau of Land Management 1103 North Fancher Road Spokane, Washington 99212-1275 (509) 536-1221 Bob Boeh Shoshone Tree Farms/Riley Creek Lumber 69 Riley Creek Park Drive Laclede, Idaho 83841 (208) 263-7574

6.1.2 Historical Information

The Sterling Mine is a former lead, zinc, and silver mine located in the Metaline mining district (Derkey 1990). The mine is reported to have produced in 1918 and 1926 (Derkey 1990). Historical ownership from the time of patent to the present is unknown.

6.1.3 Mine Description/Features

The Sterling Mine is located approximately 100 to 200 yards south of the Metaline Mine, along an unnamed tributary, approximately 150 feet west of the Pend Oreille River. The mine is located in the Yellowhead horizon (Derkey 1990). Mineralization occurs in the Metaline Formation (Derkey 1990).

6.1.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Sterling Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 2, Pages 17 and 18). The mine area consisted of a shaft measuring approximately 30 feet by 60 feet by 25 feet deep (Appendix A; Photo 11-16), wood debris, and a partial concrete foundation (Appendix A; Photo 11-17). The START-2 observed a creek flowing an estimated 60 to 80 gallons per minute (gpm) approximately 100 feet south of the mine area. The mine is approximately 150 feet west of the Pend Oreille River. The mine area is in a low point geographically; potential overland drainage routes flow to the southeast. No residents were observed on the property. No potential sources of contamination or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.2 METALINE MINE

6.2.1 Mine Location

Latitude:	48° 50' 32.64"W
Longitude:	117° 23' 24.00"N
Legal Description:	NE¼ Section 32, Township 39N, Range 43E
CERCLIS ID:	WAN001002328
County:	Pend Oreille
Contact:	Bob Boeh Shoshone Tree Tarms/Riley Creek Lumber 69 Riley Creek Park Drive PO Box 220 Laclede, Idaho 83841 (208) 263-7574

6.2.2 Historical Information

The Metaline Mine is a former lead, zinc, and silver mine located in the Metaline mining district (Derkey 1990). The Metaline Mine was the name given to an adit for mining the combined ore bodies of the Bella May, Blue Bucket, and West Contact deposits (Derkey 1990). The mine is reported to have produced 410,724 tons of ore valued at $2,573,294 from 1938 to 1947 (Derkey 1990). The mine came

under the ownership of Pend Oreille Properties in 1949 (Battien 1998). Additional historical ownership information from the time reported to the present is unknown.

6.2.3 Mine Description/Features

The Metaline Mine is located six miles from Metaline Falls (Battien 1998). Mineralization is in the dolomitic limestone and is in the Josephine horizon of the Metaline Formation (Derkey 1990). Ore at the various properties of the Metaline Mine occurs in the upper part of the Metaline Formation, within approximately 200 feet of its contact with the Ledbetter Slate (Derkey 1990).

6.2.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Metaline Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 2, Page 17). The mine area consisted of two shafts and two waste rock piles. The upper shaft measured 4 feet by 6 feet with unknown depth (Appendix A; Photos 11-13 through 11-15). The lower shaft, located approximately 50 feet downgradient from the upper shaft, measured 6 feet by 6 feet, and appears to connect with the upper shaft approximately 3 feet bgs (Appendix A; Photo 11-13). The upper waste rock pile measured 10 feet by 15 feet by 5 feet deep. The lower waste rock pile measured 50 feet by 15 feet by 5 feet deep (Appendix A; Photo 11-14). The START-2 did not observe an overland drainage route from the waste rock piles to the Pend Oreille River. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.3 BLUE BUCKET MINE

6.3.1 Mine Location

Latitude:	48° 50' 37.68"N
Longitude:	117° 23' 53.52"W
Legal Description:	N½ Section 32, Township 39N, Range 43E
CERCLIS ID:	WAN001002319
County:	Pend Oreille
Contact:	Bob Boeh Shoshone Tree Farms/Riley Creek Lumber 69 Riley Creek Park Drive P.O. Box 220 Laclede, Idaho 83841 (208) 263-7574

6.3.2 Historical Information

The Blue Bucket Mine is a former zinc, lead, and silver mine located in the Metaline mining district (Derkey 1990). The Blue Bucket Mine was the name given to an adit used to access the combined ore bodies of the Metaline, Bella May, and West Contact (Derkey 1990). The mine is reported to have produced in 1906, 1907, 1916 to 1918, 1922 to 1926, and 1937 to 1950 (Derkey 1990). Total production was 175,000 tons by 1942, with production at a rate of 200 tons/day (Derkey 1990). The total ore produced between 1937 and 1943 was 56,131 tons (Derkey 1990). Ownership history from the time of patent to the present is unknown.

6.3.3 Mine Description/Features

The Blue Bucket Mine is accessed from an unmarked forest service road. Ore bodies of various sizes tend to lie along bedding zones, probably within the upper 350 feet of the Metaline Formation, and contain sphalerite and galena associated with silicified dolomite and calcite (Derkey 1990). Ore at the Blue Bucket and adjacent mines occurs within the upper 350 feet of the Metaline Formation (Derkey 1990).

6.3.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Blue Bucket Mine and conducted a visual inspection of the property and surrounding area (Figure 6-1; Appendix C; Team 2, Pages 19 and 20). The mine area consisted of a shaft measuring 15 feet by 15 feet with unknown depth (Appendix A; Photos 12-1 through 12-3). There could be potential flow from the shaft to the unnamed creek (probable point of entry [PPE] 2). Below the unmarked forest service road a culvert (PPE 1) leads to an unnamed creek which flows through the mine shaft area and past a waste rock pile for approximately 80 feet. There could be potential overland flow from the waste rock pile to the unnamed creek (PPE 3). The START-2 estimated the flow of the creek to be 20 gpm. The culvert appeared to be galvanized metal. At the time of the visit, there was minimal (approximately 1 gpm) flow from the culvert. The waste rock pile measured 60 feet long by 50 feet wide by 15 feet deep. The START-2 did not observe any areas of obvious staining at the mine area.

6.3.5 Sampling Locations

Two co-located surface water and sediment samples were collected at the mine (Figure 6-2). Samples BBPP01SW and BBPP01SD were collected downgradient of the waste rock pile in an observed overland drainage area (PPE 3). The sediments at this sample location were sandy and multi-colored.

Samples BBPP02SW and BBPP02SD were collected near the culvert and south of the mine shaft (PPE 1). The sediments at this sample location were gray, dark brown and fine grained.

6.3.6 Analytical Results

6.3.6.1 Surface Water Sample Results

Analytes detected in BBPP01SW include calcium (84,400 micrograms per liter [µg/L]) and magnesium (15,600 µg/L). Analytes detected in BBPP02SW include calcium (84,800 µg/L), iron (125 µg/L), and magnesium (14,500 µg/L). As discussed in Section 5.1.1, the results of these common earth crust elements will not be discussed in this report.

6.3.6.2 Sediment Sample Results

Sample results are summarized in Table 6-1. Cadmium was detected at significant concentrations in BBPP01SD (1.7 mg/kg) and BBPP02SD (2.8 mg/kg). Lead was detected at significant concentrations in BBPP01SD (59.9 mg/kg) and BBPP02SD (72.5 mg/kg). Zinc was detected at a significant adjusted concentrations in BBPP01SD (219 mg/kg) and BBPP02SD (373 mg/kg).

6.4 BELLA MAY MINE

6.4.1 Mine Location

Latitude:	48° 50' 53.16"N
Longitude:	117° 24' 16.20"W
Legal Description:	SW¼ Section 29, Township 39N, Range 43E
CERCLIS ID:	WAN001002318
County:	Pend Oreille
Contact:	Bureau of Land Management 1103 North Fancher Road Spokane, Washington 99212-1275 (509) 536-1221 Bob Boeh Shoshone Tree Farms/Riley Creek Lumber 69 Riley Creek Park Drive P.O. Box 220 Laclede, Idaho 83841 (208) 263-7574

6.4.2 Historical Information

The Bella May Mine is a former zinc, lead, silver, and cadmium mine located in the Metaline mining district (Derkey 1990). The Bella May Mine was the name given to an adit used to access the combined ore bodies of the Blue Bucket, West Contact, and Metaline deposits (Derkey 1990). The mine was reported to have produced 208,678 tons of ore between 1937 to 1943 (Derkey 1990). From 1923 to 1924, over 250 tons of practically pure galena made up the shipment put together by the then owners, Oscar DeCamp and Associates (Battien 1998). Further ownership history from the time reported to the present is unknown.

6.4.3 Mine Description/Features

One adit at the mine was 6,400 feet long and there were a reported 12,000 feet of underground workings by 1956 (Battien 1998). At least two ore bodies were found in hydrothermally altered Metaline Formation about 150 feet below the Ledbetter Slate - Metaline Formation contact (Derkey 1990). Ore at the Bella May and adjacent mines occurs near the upper contact of the Metaline Formation, within about 300 feet of the contact with the Ledbetter Slate (Derkey 1990).

6.4.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Bella May Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 2, Pages 20 and 21). The mine area consisted of an upper adit measuring 6 feet by 6 feet by 30 feet deep; a lower adit measuring 5 feet by 6 feet by 50 feet deep; and a shaft measuring 5 feet by 5 feet by 30 feet deep (Appendix A; Photos 12-7 through 12-9). A waste rock pile measuring 100 feet by 50 feet by 5 feet deep was observed. The waste rock pile is adjacent to the lower adit and extends in a triangular shape to the south for approximately 100 feet (Appendix A; Photo 12-10). The START-2 did not observe any surface water features in the area and any overland drainage routes appear to end at the mine access road. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.5 DIAMOND R. MINE

6.5.1 Mine Location

Latitude:	48° 51' 12.60"N
Longitude:	117° 25' 19.20"W
Legal Description:	Near center, Section 30, Township 39N, Range 43E

CERCLIS ID:	WAN001002320
County:	Pend Oreille
Contact:	Bob Boeh Shoshone Tree Farms/Riley Creek Lumber 69 Riley Creek Park Drive P.O. Box 220 Laclede, Idaho 83841 (208) 263-7574

6.5.2 Historical Information

The Diamond R. Mine is a former lead and zinc mine located in the Metaline mining district (Derkey 1990). It is reported that one carload of ore was shipped in 1918 (Battien 1998; Derkey 1990). In 1932 the mine came under the ownership of the Metaline Mining and Leasing Company (Battien 1998). Further ownership history from the time reported to the present is unknown.

6.5.3 Mine Description/Features

Mineralization at the mine occurs as small irregular streaks of galena in brecciated dolomitic limestone (Derkey 1990). Mineralization occurs at the Josephine horizon, 35 to 150 feet below contact of the Metaline Formation with the overlying Ledbetter Slate (Derkey 1990).

6.5.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Diamond R. Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 2, Page 19). The mine area includes a partially collapsed shaft and two waste rock piles (Appendix A; Photos 11-20 through 11-24). The shaft measured approximately 60 feet by 10 feet wide by 15 feet deep. The upper waste rock pile measured approximately 10 feet by 8 feet by 2 feet deep. The lower waste rock pile is covered with vegetation and measured approximately 40 feet by 30 feet by 10 feet deep. The START-2 team located another mine area approximately 500 feet to the east of the mine. It was unclear at the time of the visit if the two areas were related. The START-2 assumes that the adjacent area is a portion of the Diamond R. Mine. The adjacent area consisted of three waste rock piles. The upper waste rock pile measured 5 feet by 5 feet by 2 feet deep. The middle waste rock pile measured 50 feet by 20 feet by 10 feet deep. The lower waste rock pile measured 60 feet by 40 feet by 10 feet deep. The START-2 did not observe any surface water features at the mine area. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.6 LEHIGH NO. 1 MINE

6.6.1 Mine Location

Latitude:	48° 51' 2.52"N
Longitude:	117° 24' 14.09"W
Legal Description:	NE¼ NE¼ Section 29, Township 39N, Range 43E
CERCLIS ID:	WAN001002325
County:	Pend Oreille
Contact:	Bob Boeh Shoshone Tree Farms/Riley Creek Lumber 69 Riley Creek Park Drive Laclede, Idaho 83841 (208) 263-7574

6.6.2 Historical Information

The Lehigh No. 1 Mine is a former iron and lead mine located in the Metaline mining district (Derkey 1990). It is reported that the mine produced 800 tons of ore prior to 1941 (Derkey 1990). Historical ownership information for the Lehigh No. 1 Mine from the time of patent to the present is unknown.

6.6.3 Mine Description/Features

Mississippi Valley-type deposits are found in lower Paleozoic miogeoclinal rocks. Ore control included oxidation of pyrite bodies. The iron oxide was used in the manufacture of cement requiring a low amount of sulfide and aluminum-bearing clays. (Derkey 1990)

6.6.4 START-2 Mine Visit

On June 26, 2001 the START-2 visited the Lehigh No. 1 Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 2, Page 21). The mine area consisted of two shafts; the horizontal shaft (shaft 1-connects with the Bella May Mine) measured approximately 15 feet by 15 feet by 100 feet deep and the nearby vertical shaft measured approximately 5 feet by 5 feet by 30 feet deep (Appendix A; Photos 12-11 through 12-15). A waste rock pile located downgradient from both shafts measured approximately 100 feet by 67 feet by 5 feet deep. The START-2 did not observe any surface water features at the mine including overland drainage routes. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.7 WEST CONTACT MINE

6.7.1 Mine Location

Latitude:	48° 51' 7.92"N
Longitude:	117°24' 56.88"W
Legal Description:	E½ Section 30, Township 39N, Range 43E
CERCLIS ID:	WAN001002332
County:	Pend Oreille
Contact:	Bob Boeh Shoshone Tree Farms/Riley Creek Lumber 69 Riley Creek Park Drive Laclede, Idaho 83841 (208) 263-7574

6.7.2 Historical Information

The West Contact Mine is a former zinc, lead, and silver mine located in the Metaline mining district (Derkey 1990). The West Contact was the name given to an adit that was used to access the combined ore bodies of the Bella May, Blue Bucket, and Metaline deposits (Derkey 1990). The production of this mine is reported along with that of the Metaline Mine (Derkey 1990). Historical ownership information for the West Contact Mine from the time of patent to the present is unknown.

6.7.3 Mine Description/Features

Ore bodies lie along bedding zones near the upper contact with the Metaline Formation (Derkey 1990). Mineralization consists of sphalerite and galena associated with silicified dolomite and calcite (Derkey 1990). Ore at the West Contact and Bella May and Blue Bucket mines occurs near the contact of the Metaline Formation with the overlying Ledbetter Slate (Derkey 1990).

6.7.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the West Contact Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 2, Page 18). The mine area consisted of a shaft measuring 10 feet by 10 feet with unknown depth (Appendix A; Photos 11-18 and 11-19). The START-2 did not observe any surface water features at the mine including overland drainage routes. No additional sources of contamination such as waste rock or tailings were observed. No residents or potential receptors were identified on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.8 LEHIGH NO. 2 MINE

6.8.1 Mine Location

Latitude:	48° 51' 31.68"N
Longitude:	117° 24' 52.20"W
Legal Description:	W½ Section 30, Township 39N, Range 43E
CERCLIS ID:	WAN001002326
County:	Pend Oreille
Contact:	Bob Boeh Shoshone Tree Farms/Riley Creek Lumber 69 Riley Creek Park Drive Laclede, Idaho 83841 (208) 263-7574

6.8.2 Historical Information

The Lehigh No. 2 Mine is a former iron mine located in the Metaline mining district (Derkey 1990). It is reported that the mine produced in 1936 (Derkey 1990). Historical ownership information for the Lehigh No. 2 Mine from the time of patent to the present is unknown.

6.8.3 Mine Description/Features

Mississippi Valley-type deposits are found in lower Paleozoic miogeoclinal rocks. Ore control included oxidation of pyrite bodies. The iron oxide was used in the manufacture of cement requiring a low amount of sulfide and aluminum-bearing clays. (Derkey 1990)

6.8.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Lehigh No. 2 Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 2, Page 23). The mine area consisted of a horizontal shaft that measured approximately 5 feet by 5 feet by 20 feet deep (Appendix A; Photos 13-3 through 13-5). The waste rock pile associated with this mine is mixed with the Lehigh No. 1 waste rock pile and measured approximately 100 feet by 67 feet by 5 feet deep. The START-2 did not observe any surface water features at the mine including overland drainage routes. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.9 ORIOLE MINE

6.9.1 Mine Location

Latitude:	48° 51' 36.72"N
Longitude:	117°24' 46.44"W
Legal Description:	SE corner, Section 19, Township 39N, Range 43E
CERCLIS ID:	WAN001002330
County:	Pend Oreille
Contact:	United States Forest Service 765 South Main Colville, Washington 99114 (509) 684-7000

6.9.2 Historical Information

The Oriole Mine is a former zinc, lead, silver, copper, and gold mine located in the Metaline mining district (Derkey 1990). The mine is reported to have produced in 1911, 1912, 1925, 1926, (total of 2,000 tons by 1942), and in 1953 (Derkey 1990). Smelter returns on a carload of handpicked ore were 42.1 ounces/ton silver, 21.9% zinc, 15.3% lead, and 1.12% copper (Derkey 1990). Historical ownership information for the Oriole Mine from the time of patent to the present is unknown.

6.9.3 Mine Description/Features

The Oriole Mine is accessed by the Oriole Road; a dirt road approximately 2 miles south of the town of Metaline. Ore is localized in a northwest-trending gouge-breccia seam (Derkey 1990). Ore bodies are a series of elongated-down-dip lenses along the fault plane; they are connected by narrow quartz stringers (Derkey 1990). Mineralization occurs in the Proterozoic Monk Formation of the Windermere Group (Derkey 1990).

6.9.4 START-2 Mine Visit

On June 27, 2001, the START-2 visited the Oriole Mine and conducted a visual inspection of the property and surrounding area (Figure 6-3; Appendix C; Team 2, Pages 23 and 24). The mine consisted of an upper adit which has been gated approximately 15 feet from the opening (Appendix A; Photos 12-16 through 12-23, 13-2, and 13-10). Five waste rock piles were present. The largest waste rock pile measured 25 feet long by 15 feet wide by 4 feet deep. A spring begins 20 feet from the adit (PPE 1) and flows approximately 75 feet where it reaches the waste rock pile (PPE 2) and continues into a muddy

area with no outflow. PPE 3 is a potential overland flow from the muddy area to Linton Creek. The START-2 estimated spring flow at 32 gpm. The northern portion of the mine consisted of a waste rock pile covered with soil. The covered waste rock pile measured 35 feet by 55 feet by 2 feet deep.

6.9.5 Sample Locations

A co-located surface water and sediment sample (ORSP01SW and ORSP01SD) was collected approximately 13 feet downstream from where the spring flows to the surface. Another sediment sample (ORSP02SD) was collected below the covered waste rock pile in the northern portion of the mine. Sample locations are depicted in Figure 6-4.

6.9.6 Analytical Results

6.9.6.1 Surface Water Sample Results

Zinc was detected at a significant concentration in ORSP01SW (102 µg/L). For purposes of this report, concentrations of substances detected in ORSP01SW are being compared to concentrations of these substances detected in POBK01SW. Zinc was detected at an estimated concentration in POBK01SW (2.8 µg/L). Other substances detected in ORSP01SW include calcium (18,900 µg/L) and magnesium (9,530 µg/L). As discussed in Section 5.1.1, the results of these common earth crust elements will not be discussed in this report.

6.9.6.2 Sediment Sample Results

Sample results are summarized in Table 6-2. Arsenic was detected at a significant concentration in ORSP02SD (13.8 mg/kg). Barium was detected at a significant concentration in ORSP02SD (234 mg/kg). Cadmium was detected at significant concentrations in ORSP01SD (8.5 mg/kg) and ORSP02SD (27 mg/kg). Copper was detected at a significant estimated low concentration in ORSP02SD (71.7 mg/kg). Lead was detected at significant concentrations in ORSP01SD (301 mg/kg) and ORSP02SD (714 mg/kg). Manganese was detected at significant concentrations in ORSP01SD (4,210 mg/kg) and ORSP02SD (2,230 mg/kg). Silver was detected at significant concentrations in ORSP01SD (208 mg/kg) and ORSP02SD (5.6 mg/kg). Zinc was detected at significant concentrations in ORSP01SD (784 mg/kg) and ORSP02SD (5,740 mg/kg).

6.10 JOSEPHINE MINE

6.10.1 Mine Location

Latitude:	48° 52' 48.00"N
Longitude:	117° 22' 15.96"W
Legal Description:	N½SE¼ Section 16, Township 39N, Range 43E
CERCLIS ID:	WAN001002322
County:	Pend Oreille
Contact:	David Godlewski Teck Cominco American Inc. 15918 East Euclid Avenue Spokane, Washington 99216-1816 (509) 892-2584

6.10.2 Historical Information

The Josephine Mine is a former zinc, lead, silver, and cadmium mine located in the Metaline mining district (Derkey 1990). Reported alternative names for the Josephine Mine include Clark Mine and Hortense Mine (Derkey 1990). The mine is reported to have produced 40,000 tons of ore valued at $275,000 prior to 1919, 243,000 tons between 1920 and 1935, and from 1936 through 1955 (Derkey 1990). Production was 187,000 tons in 1948 and 273,520 tons in 1951 (Derkey 1990). Historical ownership information for the Josephine Mine from the time of patent to the present is unknown. Currently, Teck Cominco American Inc. maintains a prospecting lease for the Josephine Mine property through 2005 (Godlewski 2001).

6.10.3 Mine Description/Features

The Josephine Mine is part of the mining properties of Pend Oreille Mines, and information is sometimes combined for these two deposits (Derkey 1990). The portal for the Pend Oreille Mine/Mill is located on the east side of the Pend Oreille River and for the Josephine Mine on the west side of the river (Derkey 1990). Ore occurs as irregular bodies of sphalerite and galena in a zone 35 to 150 feet below the upper contact of the Metaline Formation (Derkey 1990). Ore minerals (sphalerite is generally dominant) are most commonly in brecciated dolomite gangue (Derkey 1990). The ore is disseminated in silicified dolomite, especially in brecciated zones cemented by calcite (Derkey 1990). Known ore bodies are similar in size to those at the Pend Oreille Mine/Mill and range up to 5,000 feet long, 700 feet wide, and 100 feet thick (Derkey 1990). Ore at the Josephine Mine and adjacent deposits occurs in the carbonaceous and locally siliceous breccia called the Josephine horizon of the Metaline Formation

(Derkey 1990). The horizon occurs within about 35 to 200 feet of the top of the Middle Cambrian to Middle Ordovician Metaline Formation beneath the Ledbetter Slate (Derkey 1990).

6.10.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Josephine Mine and conducted a visual inspection of the property and surrounding area (Figure 6-5; Appendix C; Team 3, Page 28). The mine area consisted of a shaft, a waste rock pile, a small building, and a collapsing wood structure (Appendix A; Photos 7-10 through 8-3). The mine is located directly across the Pend Oreille River from the waste rock at the Pend Oreille Mine/Mill. The shaft is surrounded by an 8 foot barbed-wire-topped chain-link fence. The shaft was filled with water approximately 25 feet from the surface. The shaft also contained wood debris that resembled rail lines. Approximately 2 feet southwest of the collapsing wood structure a spring was observed (PPE 1). The spring was estimated to be flowing at 2 to 3 gpm. The waste rock pile measured 60 feet long by 10 feet high by 2 feet deep. The waste rock pile extended into the Pend Oreille River forming the bank of the river (PPE 2).

6.10.5 Sample Locations

A sediment sample (JOPP01SD) was collected at the PPE 2 of the waste rock into the Pend Oreille River (Figure 6-6). A surface water sample, JOSP01SW, was collected at the mouth of the spring which originated approximately 2 feet south of the wooden structure and fed into the Pend Oreille River. A co-located sediment sample was not collected due to lack of sediment.

6.10.6 Analytical Results

6.10.6.1 Surface Water Sample Results

Sample results are summarized in Table 6-3. Lead (21.5 µg/L) and zinc (117 µg/L) were detected at significant concentrations in sample JOSP01SW.

6.10.6.2 Sediment Sample Results

Sample results are summarized in Table 6-4. Cadmium (9.6 mg/kg), lead (17,400 mg/kg), mercury (0.16 mg/kg), silver (2.3 mg/kg), and zinc (2,040 mg/kg) were detected at significant concentrations in JOPP01SD.

6.11 GRANDVIEW MINE/MILL

6.11.1 Mine/Mill Location

Latitude:	48° 52' 22.04"N
Longitude:	117° 21' 26.16"W
Legal Description:	Sections 14, 15, 22, and 30, Township 39N, Range 43E
CERCLIS ID:	WASFN1002165
County:	Pend Oreille
Contact:	Mr. Arlen Looney Washington Resources P.O. Box 69 Greenacres, WA 99016 (509) 534-0266

The inactive Grandview lead-zinc mine/mill is located in the lower Pend Oreille River Valley approximately 0.75 mile from the east bank of the Pend Oreille River, approximately 2 miles northeast of Metaline Falls, Washington (Figure 6-7).

In October 2000, E & E conducted field sampling activities at the Grandview Mine/Mill. The combined PA/SI activities were conducted under TDD Nos. 00-06-0001 and 01-01-0015 issued under EPA Region 10 START Contract Nos. 68-W6-0008 and 68-S0-01-01, respectively.

The PA/SI involved collection of samples from potential sources of contamination on the property and from receptors potentially impacted through contaminant migration.

Analytical results of samples collected during the October 2000 field event can be found in the Grandview Mine PA/SI report prepared by E & E for EPA, dated June 2001. The Grandview Mine PA/SI report also includes facility background information, a discussion of field sampling activities and analytical protocols, analytical results and background sampling, QA/QC criteria, potential sources, migration/exposure pathways and targets.

In summary, samples were collected from three soil source areas including the tailings pile, waste rock piles, and an area where abandoned containers and drums were observed on the property, but were removed prior to the sampling effort (Figure 6-8). The soil sources contained significant concentrations of TAL metals. The tailings pile samples contained significant concentrations of cadmium (58.4 mg/kg), copper (91.5 mg/kg), lead (2,260 mg/kg), mercury (1.7 mg/kg JL), selenium (1.1 mg/kg), and zinc (19,100 mg/kg).

The waste rock samples contained significant concentrations of arsenic (44.0 mg/kg), cadmium (23.3 mg/kg), lead (4,930 mg/kg) mercury (1.5 mg/kg) selenium (1.5 mg/kg), and zinc (7,420 mg/kg).

Soil samples collected from the abandoned container and drum area contained significant concentrations of arsenic (64.9 mg/kg), cadmium (99.5 mg/kg), copper (236 mg/kg), lead (14,600 mg/kg), mercury (6.0 mg/kg), selenium (3.0 mg/kg), and zinc (36,200 mg/kg).

Samples were collected from suspected targets along potential groundwater migration, surface water migration, and soil exposure pathways including groundwater wells, Pend Oreille River, an unnamed spring, and a former wastewater drainage ditch (Figures 6-9 and 6-10).

Concentrations of TAL metals detected in the Pend Oreille Village groundwater samples, in comparison to the background water sample, contained elevated concentrations of arsenic (23.4 µg/L), manganese (245 µg/L), selenium (5.1 µg/L), and zinc (125 µg/L). Concentrations of TAL metals detected did not exceed Drinking Water Standards.

No elevated concentrations were detected in the Pend Oreille River surface water samples. Cadmium (1.4 mg/kg), copper (28.2 mg/kg), lead (827 mg/kg), and zinc (1,090 mg/kg) were detected at elevated concentrations in the Pend Oreille River sediment samples.

Elevated concentrations were detected in the unnamed spring surface water samples, including arsenic (10.4 µg/L), lead (1,340 µg/L), manganese (101 µg/L), selenium (6.7 µg/L), and zinc (547 µg/L). Elevated concentrations were detected in the unnamed spring co-located sediment samples including cadmium (63.9 mg/kg), chromium (25.2 mg/kg), copper (120 mg/kg), lead (11,800 mg/kg) selenium (2.4 mg/kg), thallium (4.9 mg/kg), and zinc (19,800 mg/kg).

Elevated concentrations were detected in the former wastewater drainage ditch surface soil samples including arsenic (31.2 mg/kg), cadmium (41.8 mg/kg), chromium (133 mg/kg), copper (3,730 mg/kg), lead (43,000 mg/kg), mercury (3.9 mg/kg), selenium (6.4 mg/kg), silver (7.4 mg/kg), and zinc (12,100 mg/kg).

Radionuclide data were evaluated with respect to measured background concentrations. For radionuclide data, results normally are considered elevated or significant when the sample concentration exceeds the value of two standard deviations above the mean site-specific background concentration for that radionuclide. However, only one background sample was required to meet the DQOs identified for the Grandview Mine PA/SI. Further, additional background samples are necessary to define the variability of the background population to accurately determine if radionuclides from the Grandview Mine/Mill are impacting identified targets. To date, there is no conclusive evidence suggesting off-site contamination from radionuclides present at Grandview Mine/Mill. A more detailed discussion and evaluation of the data collected for the Grandview Mine/Mill site can be found in the Grandview Mine PA/SI report prepared by E & E for EPA, dated June 2001.

6.11.2 Sample Locations

During the June 2001 field event, two co-located surface water and sediment samples were collected at the PPEs of Grandview Mine/Mill (GMPP04SW/SD [PPE 1] and GMPP05SW/SD [PPE 2]) in between the Pend Oreille Mine/Mill and the co-located background sample POBK01SW/SD (Figure 6-12).

6.11.3 Analytical Results

6.11.3.1 Surface Water Sample Results

Sample results are summarized in Table 6-5. Lead was detected at a significant concentration in GMPP05SW (4.1 µg/L). Manganese was detected at a significant concentration in GMPP05SW (25.5 µg/L). Zinc was detected at a significant concentration in GMPP05SW (20.6 µg/L).

6.11.3.2 Sediment Sample Results

Sample results are summarized in Table 6-6. Cadmium was detected at a significant concentration in GMPP05SD (1.6 mg/kg). Lead was detected at a significant concentration in GMPP05SD (449 mg/kg). Zinc was detected at a significant concentration in GMPP05SD (864 mg/kg).

6.12 PEND OREILLE MINE/MILL

6.12.1 Mine/Mill Location

Latitude:	48° 52' 54.12"N
Longitude:	117° 21' 36.00"W
Legal Description:	N½ Sections 10,11,14, and 15, Township 39N, Range 43E
CERCLIS ID:	WASFN1002160
County:	Pend Oreille
Contact:	David Godlewski Teck Cominco American Inc. 15918 East Euclid Avenue Spokane, Washington 99216-1816 (509) 892-2584

6.12.2 Historical Information

The Pend Oreille Mine/Mill is an active zinc-lead mine/mill located in the Metaline mining district (Derkey 1990). The Pend Oreille Mine/Mill is a collective name for several properties

(Derkey 1990). Production in 1915 was 3,111 tons valued at $8.76 per ton from the Clark Property (Derkey 1990). The mine produced 123,751 tons of ore in 1948 and 186,955 tons were produced in 1949 (Derkey 1990). Yield from 186,197 tons of ore in 1950 was 9,580,731 pounds of zinc, 6,336,653 pounds of lead, 18,000 ounces of silver, and 30,000 pounds of cadmium (Derkey 1990). Yield from 273,580 tons of ore in 1951 was 12,950,584 pounds of zinc, 6,045,914 pounds of lead, and 16,041 ounces of silver (Derkey 1990). The Pend Oreille Mine/Mill produced 5,451,328 tons of ore through 1956 (Derkey 1990).

The Pend Oreille Mine/Mill is located about 2 miles north of the town of Metaline Falls and approximately 80 miles north of Spokane in northeastern Washington State. The mine is about 11 miles south of the International Border and about 15 miles west of the Idaho border. The Pend Oreille Mine/Mill is bounded on the west by Pend Oreille River, on the north and northeast corner by Colville National Forest lands, on the east by privately-owned lands, and on the south by State Route 31 and the Grandview Mine/Mill property (USGS 1992a, 1992b).

Ownership of the Pend Oreille Mine/Mill dates back to 1904, when L.P. Larsen began prospecting in this location. In 1906, Pend Oreille Mines & Metals Company was incorporated and L.P. Larsen became the president (Lasmanis 1995). The Pend Oreille Mine/Mill was owned and operated by Pend Oreille Mines & Metals Company until 1974, when the Bunker Hill Company acquired the property and operations. The Bunker Hill Company operated the mine and mill until September 1977, when the property was acquired by Pintlar Corporation (Pintlar), a wholly-owned subsidiary of Gulf Resources & Chemical Corporation (GRC). In 1988, Resource Finance Corporation (RFC) obtained an option-purchase agreement from Pintlar, de-watered the mine, and commissioned a feasibility study for mining and milling the East Side Yellowhead deposit. In May 1990, RFC purchased the mine and mill along with 13,000 acres of contiguous mineral holdings in the district (Ecology 2000). In 1996, Cominco American, Inc. acquired a portion of this property, including the Pend Oreille Mine/Mill, from RFC (Ecology 2000). Cominco American Inc. and Teck Cominco American Inc. merged in mid year 2001 forming Teck Cominco American Inc. (Hallinan 2001).

The Pend Oreille Mine/Mill property is included in the 580 acres of Teck Cominco American Inc.-owned or leased surface lands (including mineral rights) and 980 additional acres of mineral rights in this area (Ecology 2000).

6.12.3 Mine/Mill Description/Features

Most production at the Pend Oreille Mine/Mill was from irregularly shaped bodies of sphalerite and galena in a zone called the Josephine horizon, 35 to 200 feet below the contact of the Metaline Formation with the overlying Ledbetter Slate (Derkey 1990). The Yellowhead ores occur about 1,000 feet below the upper contact of the Metaline Formation (Derkey 1990). Ore minerals (sphalerite generally dominant) are most commonly in brecciated dolomite gangue (Derkey 1990). Ore bodies range up to 5,000 feet long, 700 feet wide, and 100 feet thick (Derkey 1990).

The Pend Oreille Mine/Mill was one of the earliest, largest, and most productive mines in the Metaline mining district, accounting for over 50% of the lead and zinc production in the area (Ecology 2000).

Two ore horizons are present at the Pend Oreille Mine/Mill, the Josephine and the Yellowhead. The Josephine Horizon is found in the upper 500 feet of the Metaline Limestone, or about 1,600 feet below the surface. The Yellowhead Horizon is beneath the Josephine Horizon and is generally found from 1,000 to 2,400 feet beneath the top of the Metaline Limestone (Ecology 2000).

The primary method for extracting ore in the Metaline Mining District, including the Pend Oreille Mine/Mill, has been underground mining. Historically, most ore extraction was from the Josephine Horizon, which is exposed at the surface at Pend Oreille River. This horizon has been mostly mined out. (Ecology 2000)

Mining in the area by the Pend Oreille Mines & Metals Company was on a small scale during the early years, beginning on the Josephine claim with near-surface deposits on the west side of Pend Oreille River; mining continued here intermittently from 1904 until 1917 (Dings and Whitebread 1965). In 1917, a table concentration mill was constructed and operated for a few months, but was shut down during World War I. There was little activity for the next 10 years. (Ecology 2000)

In 1927, the old table mill was remodeled to a flotation plant which operated on surface ores at 150 tons per day for approximately six months. In 1928, Pend Oreille Mines & Metals Company began additional deeper development of the area; a program of extensive diamond drilling from 1928 to 1930 disclosed promising ore bodies. With a 300-ton flotation mill completed in anticipation of treating this ore, mining resumed in November 1930 and continued intermittently until 1937. The underground workings were developed, with ore hauled to the surface through a network of track haulage drifts and inclined shafts. In September 1937, a power plant on the Pend Oreille River was completed, the mill was overhauled, and production was increased to approximately 600 tons per day (Lambly 1941; Zeigler 1949; Dings and Whitebread 1965).

Subsequent workings on the Josephine Horizon were conducted eastward and downward, crossing under the river in the 1940s. Approximately 14.4 million tons of ore at 1.2% lead and % zinc were removed from this horizon between 1938 and 1977 (RFC 1993).

Mining of the Yellowhead Horizon on the east side of the river began in 1972 at an elevation about 650 to 900 feet below the Josephine workings. Only 387,000 tons of ore containing 0.5% lead and 4.0% zinc were removed from this horizon prior to closure of the mine in 1977. Since 1977, there have been no mining operations other than a development program (Lasmanis 1995; Godlewski 2000).

Prior to 1967, tailings from the milling operation—the finely ground sand and silt material remaining after the target minerals have been separated during beneficiation—were disposed of directly into Pend Oreille River. Beneficiation includes those activities that serve to separate and concentrate the mineral values from waste material, remove impurities, or prepare the ores for further refinement (EPA 2000b). An estimated 3,000 tons of tailings were discharged to Pend Oreille River each day of milling operations in 1962 (Neale 1962). After 1967, three upland tailings disposal facilities (TDFs) were used to dispose of the tailings. TDF No. 1 (TDF-1), which is located 2,400 feet northeast of the mill and west of the Metaline Falls Golf Course and Gun Club, covers approximately 24 acres. This facility was used from 1967 through 1974. TDF No. 2 (TDF-2), which is located between the golf course and TDF-1, covers approximately 25 acres; this facility was used during 1974 and 1975. Tailings in these two TDFs are comprised of material from the Josephine Horizon workings (Ecology 2000).

TDF No. 3 (TDF-3) is located south of the golf course and covers approximately 20 acres. TDF-3 was operated from 1975 until the mine closed in 1977. The tailings in this facility are approximately 40 feet deep at the deepest point and are comprised primarily of material from the Yellowhead Horizon workings (Ecology 2000). Pend Oreille River is approximately 3,500 feet west of TDF-3.

Historically, waste rock—the waste material consisting of non-mineralized and low-grade mineralized rock removed from, around, or within the orebody during extraction activities—was stored underground during early operations. From 1950 to 1977, waste rock from both the Josephine and Yellowhead horizons, as well as Ledbetter Slate, was removed from the mine by conveyors from the Josephine Horizon to the surface, and stored in the waste rock pile located 150 feet south and west of the mill. Most of the waste rock has a low pyrite content and consists of carbonate material (limestone and dolomite) removed from above and below the ore horizons that were mined. Some of the waste rock brought to the surface was sold and used locally as road material or in construction from at least the mid-1970s until the early 1990s (Ecology 2000). The waste rock was used as a road construction base,

subbase, and surface material; for private driveways; as parking lot material at Gardner Cave State Park; and as backfill by the county (Ecology 2000). The total amount of waste rock used for these purposes is unknown. The waste rock pile currently consists of approximately 386,000 cubic yards of waste rock, and covers about 15 acres (Ecology 2000).

Between 1977 and 1986, Bunker Hill Company, Pintlar, and GRC continued exploration in the area and operated pumps to prevent flooding of the mine by underground water. The mine water was discharged into Pend Oreille River. The mine was allowed to flood between 1986 and 1988, at which time development ceased (Ecology 2000).

After purchasing the property in 1990, RFC submitted a proposal to Ecology in 1992 to reopen the mine, and submitted a State Environmental Policy Act (SEPA) checklist for the proposed project in February 1993. Ecology reviewed the SEPA checklist and issued a "Determination of Non-Significance" in April 1993. RFC then submitted several applications to Ecology to obtain permits required to reopen the mine. By 1994, RFC had obtained four permits (stormwater discharge, dam safety, septic system, and air quality) and was close to receiving two others (National Pollutant Discharge Elimination System [NPDES] and waste discharge) when RFC decided to cancel the project. The following permits are maintained: NPDES, Waste Identification, Stormwater General, Ground Water, State Dangerous Waste Conditional Exemption, and Dam Safety (Godlewski 2001).

Hazardous materials used during earlier mining operations and stored on the Pend Oreille Mine/Mill property were removed from the site during RFC's tenure in 1992. These wastes included PCB oil-cooled transformers and capacitors, as well as soils containing PCBs (Ecology 2000). The data reviewed did not specify waste quantities or disposal locations. Oil, lubricants, light fuels, antifreeze, and herbicides are reportedly the only hazardous materials currently stored on site. The materials are stored in a shed located between the administrative office and the machine shop.

Having acquired the property in 1996, Cominco American, Inc. submitted a *Statement of Proposal Pend Oreille Mine, Pend Oreille County, Washington*, to Ecology on January 29, 1998, in order to reopen the mine. Based on the proposal, Ecology determined that an Environmental Impact Statement (EIS) would be required before the mine could be reopened (Ecology 2000). The EIS was finalized on July 12, 2000 (Hallinan 2002).

The Pend Oreille Mine/Mill owner, Teck Cominco American Inc., has finished earthwork for its TDF this past year. This includes the basin floor, construction of the tailings embankment to form a closed basin and contouring the side slopes to a uniform grade. The work has been completed under permit from Ecology. The liner system for the TDF will be constructed in 2002 or 2003. Two raises, or

small shafts, have been constructed to surface for air control of the mine. These are located between the mine and the lower road as per the EIS. The foundation for the concentrate load-out building along the west side of the mill has been constructed. The new powerline from Highway 31 has been installed and electrical service upgraded to specifications. Fencing and gates have been installed to limit access to the TDFs and the mine. The company plans to re-start mining and milling operations in January 2004. Teck Cominco American Inc. is continuing to dewater the mine workings, under their NPDES permit. There is exploration occurring underground in the mine shaft to the ore body. (Hallinan 2001, Godlewski 2001). The onsite well is being used by the mine. It has been permitted for use by the Washington Department of Health as a Group B Water System identification number 08269Y, under Department of Health identification number 01-0804.

6.12.4 START-2 Mine Visit

On June 25 and 26, 2001, the START-2 visited the Pend Oreille Mine/Mill and conducted a visual inspection of the property and the surrounding area (Figure 6-11; Appendix C; Team 2, Pages 15 and 16; Team 3, Page 27; Project Management, Logbook 15, Pages 6 through 19; Boat Team, Pages 4 through 11)

Existing Pend Oreille Mine/Mill facilities on the east side of the river include the mine office building, maintenance shop/blacksmith shop/surface conveyor/portal, coarse and fine ore storage silos, mill, assay office building, and storage facilities (Figure 6-12).

The mine office building is a two-story reinforced concrete frame structure with concrete block walls. The building has 5,500 square feet per floor. The lower floor is used for offices, accounting, and lab facilities; the upper floor is used for storage, a training room, and two offices.

The maintenance shop/blacksmith shop is a 10,500-square-foot, 30-foot-high, reinforced concrete building with a flat roof. The conveyor that carries the ore to the coarse ore storage silo is an elevated, steel-frame, integral truss structure supported on steel bents. The shop contains machinery, tools, welding equipment, electrical equipment, lubricants, and chemicals.

Two coarse ore and three fine ore storage silos are on the property. The capacity of each ore silo is approximately 1,000 tons.

The mill is a four-story concrete block building with steel interior framework. Mill equipment includes three primary head ball mills, two regrind ball mills, flotation cells, lead and zinc thickeners, stock tanks, a water filter, and a concentrate storage area. The assay office building consists of a lower story used for storage, and an upper story containing laboratory facilities.

Other buildings on the mine property include storage sheds; a powder magazine; a make-up house; a car barn/carpenter shop; a core storage shed; a crusher building; an upper, main, and mill substation; and a compressor house.

A waste rock pile from historic mining activities is located just southeast of the ore storage silos and mine office (Appendix A; Photos 1-22 through 2-5). Three TDFs from historic mining activities are located on the mine property. The Metaline Falls Golf Course and Gun Club is also located within the property boundary, just east of TDF-2 (Ecology 2000).

6.12.5 Sample Locations

Samples were collected at sources, including the waste rock pile and three TDFs/tailings piles, receptors discussed in Section 7 of this report, and four PPEs (Figure 6-12).

Three waste rock samples (POWP01SS through POWP03SS) were collected from the waste rock pile located adjacent to the Pend Oreille River on the south end of the property. The samples were collected within the overland surface water drainage routes identified by the START-2. The samples were collected to determine potential contamination associated with this source. The samples appeared to consist of dark gray and brown rocks. No odor or staining was noted during the sample collection.

Three surface soil samples were collected at each tailings pile for a total of 9 surface soil samples. Three surface soil samples (POTP01SS through POTP03SS) were collected at TDF-1, three surface soil samples (POTP04SS through POTP06SS) were collected at TDF-3, and three surface soil samples (POTP07SS through POTP09SS) were collected at TDF-2. Soil from TDF-1 was uniform and appeared to consist of moist, gray clay with waste rock. No soil odor or staining was noted during the sample collection. Soil from TDF-3 was uniform and appeared to consist of dry, white and dark brown sand and tailings. No soil odor or staining was noted during the sample collection. Soil from TDF-2 was uniform and appeared to consist of dry, fine gray and dark brown sand and tailings. No soil odor or staining was noted during the sample collection.

PPE 1 (POPP01SW) was collected at the ventilation shaft which flows approximately 1,260 feet in a northwest direction towards the Pend Oreille River.

PPE 2 (POPP02SW and POPP02SD) was collected from the Pend Oreille River near two seep areas located by TDF-2 and TDF-3. The water in these seeps appears to originate from hill slopes and from TDF-2. This seepage is collected in diversion channels and routed around and to the base of TDF-1, where it meets with natural seepage. This water then flows downslope (Creek 2) and drains into

Pend Oreille River (PPE 2). Surface water runoff from TDF-1 and TDF-2 drains into installed diversion ditches which drain into Pend Oreille River. (Ecology 2000)

PPE 3 (POPP03SW and POPP03SD) was collected in the surface water drainage runoff from the waste rock which drains by sheet flow into the confluence of Flume Creek and the Pend Oreille River.

Potential PPE 4 was identified at the confluence of Creek 1 to the Pend Oreille River where tailings and other contaminants potentially drained in historic operations.

6.12.6 Analytical Results

6.12.6.1 Surface Soil Sample Results

Sample results are summarized in Table 6-7. Sample locations are presented in Figure 6-12. In the waste rock pile, arsenic was detected at significant concentrations in POWP02SS (21.8 mg/kg) and POWP03SS (35.1 mg/kg). Cadmium was detected at significant concentrations in POWP01SS (4.0 mg/kg), POWP02SS (34.2 mg/kg), and POWP03SS (44.1 mg/kg). Lead was detected at significant adjusted concentrations in POWP01SS (2,090 mg/kg), POWP02SS (5,625 mg/kg), and POWP03SS (4,188 mg/kg). Mercury was detected at significant concentrations in POWP02SS (0.16 mg/kg) and POWP03SS (0.19 mg/kg). Selenium was detected at significant concentrations in POWP01SS (3.1 mg/kg) and POWP03SS (1.7 mg/kg). Zinc was detected at significant concentrations in POWP01SS (890 mg/kg), POWP02SS (7,420 mg/kg), and POWP03SS (9,300 mg/kg).

In TDF-1, arsenic was detected at a significant concentration in POTP01SS (20.6 mg/kg). Cadmium was detected at significant concentrations in POTP01SS (15.0 mg/kg) and POTP03SS (9.2 mg/kg). Copper was detected at a significant estimated concentration in POTP01SS (176 mg/kg). Lead was detected at significant concentrations in POTP01SS (680 mg/kg) and POTP03SS (467 mg/kg). Mercury was detected at significant concentrations in POTP01SS (0.25 mg/kg) and POTP03SS (0.16 mg/kg). Zinc was detected at significant adjusted concentrations in POTP01SS (2,753 mg/kg) and POTP03SS (1,460 mg/kg).

In TDF-3, arsenic was detected at significant concentrations in POTP05SS (40.0 mg/kg) and POTP06SS (20.8 mg/kg). Cadmium was detected at significant concentrations in POTP04SS (8.5 mg/kg), POTP05SS (8.2 mg/kg), and POTP06SS (11.9 mg/kg). Copper was detected at significant estimated concentrations in POTP04SS (90.0 mg/kg) and POTP06SS (178 mg/kg). Lead was detected at significant concentrations in POTP04SS (666 mg/kg), POTP05SS (1,650 mg/kg), and POTP06SS (818 mg/kg). Mercury was detected at significant concentrations in POTP04SS (0.15 mg/kg), POTP05SS (0.10 mg/kg), and POTP06SS (0.18 mg/kg). Silver was detected at a significant

concentration in POTP05SS (2.3 mg/kg). Zinc was detected at significant adjusted concentrations in POTP04SS (1,060 mg/kg), POTP05SS (1,667 mg/kg), and POTP06SS (1,680 mg/kg).

In TDF-2, arsenic was detected at significant concentrations in POTP07SS (26.4 mg/kg), POTP08SS (22.4 mg/kg), and POTP09SS (21.1 mg/kg). Cadmium was detected at significant concentrations in POTP07SS (30.4 mg/kg), POTP08SS (20.1 mg/kg), and POTP09SS (10.4 mg/kg). Copper was detected at significant estimated concentrations in POTP07SS (242 mg/kg), POTP08SS (113 mg/kg), and POTP09SS (88.0 mg/kg). Lead was detected at significant concentrations in POTP07SS (1,760 mg/kg), POTP08SS (1,000 mg/kg), and POTP09SS (919 mg/kg). Mercury was detected at significant concentrations in POTP07SS (0.58 mg/kg), POTP08SS (0.25 mg/kg), and POTP09SS (0.16 mg/kg). Zinc was detected at significant adjusted concentrations in POTP07SS (4,360 mg/kg), POTP08SS (3,027 mg/kg), and POTP09SS (1,513 mg/kg).

6.12.6.2Surface Water Sample Results

Sample results are summarized in Table 6-8. Sample locations are presented in Figure 6-12. Lead was detected at significant concentrations in POPP01SW (8.7 µg/L) and POPP02SW (9.3 µg/L). Manganese was detected at a significant concentration in POPP02SW (33.0 µg/L). Zinc was detected at significant concentrations in POPP01SW (212 µg/L) and POPP02SW (62.5 µg/L).

6.12.6.3Sediment Sample Results

Sample results are summarized in Table 6-9. Sample locations are presented in Figure 6-12. Cadmium was detected at a significant concentration in POPP02SD (6.1 mg/kg). Lead was detected at a significant concentration in POPP02SD (346 mg/kg). Zinc was detected at a significant concentration in POPP02SD (2,370 mg/kg).

6.13 YELLOWHEAD MINE

6.13.1 Mine Location

Latitude:	48° 52' 59.88"N
Longitude:	117° 22' 14.16"W
Legal Description:	NE¼ Section 16, Township 39N, Range 43E
CERCLIS ID:	WAN001002333
County:	Pend Oreille

Contact: David Godlewski
Teck Cominco American Inc.
15918 East Euclid Avenue
Spokane, Washington 99216-1816
(509) 892-2584

6.13.2 Historical Information

The Yellowhead Mine is a former zinc, lead, and silver mine located in the Metaline mining district (Derkey 1990). The mine is reported to have produced prior to 1956 with a total production of approximately 12,000 tons (Derkey 1990). Historical ownership information for the Yellowhead Mine from the time of patent to the present is unknown.

6.13.3 Mine Description/Features

Unlike mineralization on the Josephine horizon at the adjacent Josephine deposit, mineralization at the Yellowhead mine occurs on the Yellowhead horizon, about 1,000 feet from the upper contact of the Metaline Formation (Derkey 1990). The mineralogy is the same as that at the Josephine; however, the proportions are quite different (Derkey 1990). Pyrite and sphalerite are the dominant minerals, and galena is subordinate in the Yellowhead horizon ores (Derkey 1990).

6.13.4 START-2 Mine Visit

On June 26, 2001, the START-2 visited the Yellowhead Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 3, Page 28). The mine area consisted of one waste rock pile and a collapsed wood structure (Appendix A; Photos 8-4 and 8-5). The waste rock pile measured 33 feet long by 25 feet high by 2 feet deep. An area of approximately 1,000 square feet behind the collapsed wood structure was also covered with waste rock in a scattered formation. Samples were not collected at this location because the origin of the waste rock could not be positively associated with the Yellowhead Mine or the Gold Hill Mine located 0.1 mile west of the Yellowhead mine, which is not a part of this field effort. The overland drainage route flowed approximately 600 feet into the Pend Oreille River from the waste rock area. No residents or potential receptors were observed on the property.

6.14 HOAGE MINE

6.14.1 Mine Location

Latitude:	48° 56' 57.48"N
Longitude:	117° 21' 18.00"W
Legal Description:	center S½ Section 22, Township 40N, Range 43E
CERCLIS ID:	WAN001002321
County:	Pend Oreille
Contact:	United States Forest Service 765 South Main Colville, Washington 99114 (509) 684-7000

6.14.2 Historical Information

The Hoage Mine is a former zinc and lead mine located in the Metaline mining district (Derkey 1990). The reported alternative name for the Hoage Mine is the Dreadnaught-Emily Mine (Derkey 1990). Thirty tons of hand-sorted ore was piled at the mine portal in 1945, and 200 tons of lower grade ore was stockpiled in 1951 (Derkey 1990). About 50 tons of hand-sorted ore was reportedly shipped to the Pend Oreille Smelter (Derkey 1990). Historical ownership information for the Hoage Mine from the time of patent to the present is unknown.

6.14.3 Mine Description/Features

Ore minerals are disseminated in silicified dolomite (Derkey 1990). Mineralized outcrops are exposed in several places along a 1,200-foot strike length (Derkey 1990). Mineralization at the Hoage, unlike that at the nearby Lead King deposit, occurs in gray limestone at a considerable distance stratigraphically below the Josephine horizon (Derkey 1990).

6.14.4 START-2 Mine Visit

On June 28, 2001, the START-2 visited the Hoage Mine and conducted a visual inspection of the property and the surrounding area (Appendix C; Team 3, Page 34). The mine area consisted of one waste rock pile and one shaft (Appendix A; Photos 8-21 and 8-22). The shaft measured 6 feet across by 8 feet wide with unknown depth (Appendix A; Photo 8-22). Water was present in the shaft 15 feet bgs. The waste rock pile measured 30 feet by 30 feet by 1 foot deep. The START-2 did not observe any surface

water features at the mine including overland drainage routes. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.15 LUCKY STRIKE MINE

6.15.1 Mine Location

Latitude:	48° 55' 49.80"N
Longitude:	117° 19' 51.24"W
Legal Description:	NW¼ NE¼ Section 35, Township 40N, Range 43E
CERCLIS ID:	WAN001002327
County:	Pend Oreille
Contact:	United States Forest Service 765 South Main Colville, Washington 99114 (509) 684-7000 Bureau of Land Management 1103 North Fancher Road Spokane, Washington 9921201275 (509) 536-1221 David Godlewski Teck Cominco American Inc. 15918 East Euclid Avenue Spokane, Washington 99216-1815 (509) 892-2584

6.15.2 Historical Information

The Lucky Strike Mine is a former zinc, lead, and iron mine located in the Metaline mining district (Derkey 1990). A reported alternative name for the Lucky Strike Mine is the Buzzell Mine (Derkey 1990). The mine is reported to have produced in 1922 and in 1925 (Derkey 1990). Historical ownership information from the time of patent to the present is unknown.

6.15.3 Mine Description/Features

Mineralization occurs in a breccia zone as much as four feet in width (Derkey 1990). Parts of the zone are nearly solid pyrite (Derkey 1990). Mineralization at the Lucky Strike Mine occurs in the Yellowhead horizon, about 1,000 feet from the contact of the Metaline Formation with the overlying Ledbetter Slate (Derkey 1990). The mineralogy of the Yellowhead horizon ore is the same as that of the

Josephine; however, the proportions are quite different, in the Yellowhead pyrite is dominant along with galena and subordinate sphalerite (Derkey 1990). Ore samples indicate sulfide mineralization occurs in the matrix of a dolomite breccia (Derkey 1990).

6.15.4 START-2 Mine Visit

On June 27, 2001, the START-2 visited the Lucky Strike Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 3, Page 30). The mine area consisted of one dry adit and a shaft approximately 80 feet apart from each other (Appendix A; Photos 8-10 through 8-12). The shaft measured 6 feet in width by 8 feet in length by unknown depth. Less than 1,000 cubic yards of waste rock was present surrounding the adit. The START-2 did not observe any surface water features at the mine including overland drainage routes. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.16 LEAD KING MINE

6.16.1 Mine Location

Latitude:	48° 56' 16.44"N
Longitude:	117° 21' 13.32"W
Legal Description:	Near center, Section 27, Township 40N, Range 43E
CERCLIS ID:	WAN001002324
County:	Pend Oreille
Contact:	United States Forest Service 765 South Main Colville, Washington 99114 (509) 684-7000

6.16.2 Historical Information

The Lead King Mine is a former lead, zinc, and silver mine located in the Metaline mining district (Derkey 1990). A reported alternative name for the Lead King Mine is the D. Aldrich Mine (Derkey 1990). It is reported that small quantities of shipments were made in 1917 to 1918 and in 1925 to 1926 (Derkey 1990). On the Boundary Road north of Metaline Falls, and one mile west of the Pend Oreille River, the Lead King Mine was one of the first locations on the west side of the Pend Oreille River (Battien 1998). The mine had six claims and was up to ten when it became a Pend Oreille holding

(Battien 1998). Additional historical ownership information from the time reported to the present is unknown.

6.16.3 Mine Description/Features

Mineralization occurs in quartz and dolomite breccia, is of low grade, and is confined to the upper 100 feet of the Metaline Formation (Derkey 1990). Ore is irregularly distributed galena and sphalerite associated with jasperoid, dolomite, and calcite in breccia zones (Derkey 1990). Mineralization is from the Josephine horizon, 35 to 150 feet below the contact of the Metaline Formation with the overlying Ledbetter Slate (Derkey 1990). At the Lead King Mine, the country rocks are fine-grained gray limestone and large irregular bodies of gray to black crystalline dolomite (Derkey 1990).

6.16.4 START-2 Mine Visit

On June 28, 2001, the START-2 visited the Lead King Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 3, Page 35). The mine area consisted of two adits with ponded water (Appendix A; Photos 8-23 and 8-24). Although ponded water existed at each adit, neither adit was flowing at the time of the visit. Both of the adits were associated with waste rock piles. The waste rock pile at adit 1 measured 30 feet by 30 feet by 1 foot deep (Appendix A; Photo 9-1). The waste rock pile at adit 2 measured 30 feet by 60 feet by 1 foot deep (Appendix A; Photo 8-25). The START-2 did not observe any overland drainage routes from the adits to a surface water body. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.17 Z CANYON MINE

6.17.1 Mine Location and Description

The Z Canyon Mine is a former lead, zinc, and gold mine located in the Metaline mining district (Derkey 1990). The mine is located on the east side of the Pend Oreille River (Derkey 1990). The legal description of the property is NW¼ NW¼ Section 11, Township 40N, Range 43E, Pend Oreille County, Washington. The mine is reported to have produced a small amount of ore in 1926 (Derkey 1990). The mineralized zone has been exposed for a length of 800 feet on the surface (Derkey 1990). The mine is in coarse-grained dolomite, dolomite limestone, and strongly sheared limestone that is probably within the upper 200 to 400 feet of the Metaline Formation (Derkey 1990).

6.17.2 START-2 Mine Visit

One June 27, 2001, the START-2 attempted to locate the Z Canyon Mine (Appendix C; Team 3, Page 31). The START-2 followed directions given by a local resident who described where the mine was located. Upon arrival, there were no visible signs of the Z Canyon Mine. It is possible the former mine is now underwater from the creation of the Boundary Dam (Appendix A; Photo 8-13). No samples were collected.

6.18 LEAD QUEEN MINE

6.18.1 Mine Location and Description

The Lead Queen Mine is a former lead and zinc mine located in the Metaline mining district (Derkey 1990). The legal description of the property is SE¼ Section 11, Township 40N, Range 43E, Pend Oreille County, Washington. Most of the prospecting at the Lead Queen Mine was in a zone of dolomite within 150 feet of an overlying gray limestone (Derkey 1990). Mineralization occurs in quartz and dolomite breccia, is of low grade, and is confined to the upper 100 feet of the Metaline Formation (Derkey 1990). Ore is irregularly distributed galena and sphalerite associated with jasperoid, dolomite, and calcite in breccia zones (Derkey 1990).

6.18.2 START-2 Mine Visit

One June 27, 2001, the START-2 attempted to locate the Lead Queen Mine (Appendix C; Team 3, Page 31). The START-2 followed directions given by a local resident who described where the mine was located. Upon arrival, there were no visible signs of the Lead Queen Mine, other than a collapsed wood structure (Appendix A; Photo 8-14). The START-2 did not observe any surface water features at the property including overland drainage routes. No residents or potential receptors were observed on the property. No samples were collected.

6.19 LEAD HILL MINE

6.19.1 Mine Location

Latitude:	48° 58' 12.72"N
Longitude:	117° 11' 49.56"W
Legal Description:	Sections 11, 12, 13, 22, 23, 27, and S½ NE¼ Section 14, Township 40N, Range 44E

CERCLIS ID:	WAN001002323
County:	Pend Oreille
Contact:	United States Forest Service 7665 South Main Colville, Washington 99114 (509) 684-7000

6.19.2 Historical Information

The Lead Hill Mine is a former lead, zinc, and silver mine located in the Metaline mining district (Derkey 1990). A reported alternative name for the Lead Hill Mine is the Bunker Hill Mine (Derkey 1990). The mine is reported to have produced one small carload of hand-picked galena that was shipped in 1937 (Derkey 1990). The mine also milled 1,230 tons of ore in 1951 and 9,570 tons in 1952 (Battien 1998; Derkey 1990). By 1945, the Lead Hill Mine came under American Zinc holdings (Battien 1998). Historical ownership information from the time reported to the present is unknown.

6.19.3 Mine Description/Features

The Lead Hill Mine is located on the upper portion of Slate Creek (Derkey 1990). The mine consisted of 50 claims and had development including a compressor, shop buildings, and 100-ton ore bins (Battien 1998). The ore zones at the Lead Hill Mine are horizontal and gently dipping (Derkey 1990). The country rock is chiefly Metaline Formation and minor Ledbetter Slate, indicating the mine is near the Metaline-Ledbetter contact (Derkey 1990). The host dolomite is brecciated (Derkey 1990).

6.19.4 START-2 Mine Visit

On June 28, 2001, the START-2 visited the Lead Hill Mine and conducted a visual inspection of the property and surrounding area (Appendix C; Team 3, Page 33). The mine area consisted of three adits with associated waste rock, one shaft, a concrete slab, and a collapsed wood structure (Appendix A; Photos 8-15 through 8-18). The adits were dry and were located along Forest Service Road 300 with waste rock on the hillside below the road. The waste rock was spread thinly over the entire property. The waste rock was not sampled due to a lack of fine-grained material. Both adits and the shaft have been contained with gates, which were installed by the USFS in 2000. The distance between adit 1 to adit 2 is 300 feet. The distance between adit 2 and adit 3 is 20 feet. The distance from adit 3 to the shaft is 225 feet. Adit 1 has a diameter of 10 feet and adit 2 and adit 3 both have a diameter of 5 feet. The

START-2 did not observe any overland drainage routes from the adits to a surface water body. No residents or potential receptors were observed on the property. Therefore, based on EPA TM guidance, no samples were collected.

6.20 KING TUT MINE

6.20.1 Mine Location and Description

The King Tut Mine is a former lead, zinc, and silver mine located in the Metaline mining district (Derkey 1990). The legal description of the property is Sections 2 and 11, Township 40N, Range 44E, Pend Oreille County, Washington. It is reported that crude lead ore was shipped which yielded 83.4% lead and 2.3 ounces/ton of silver (Derkey 1990). The deposit occurs in silicified limestone and has been traced by open cuts for a length of 500 feet and a width of 8 feet (Derkey 1990).

6.20.2 START-2 Mine Visit

One June 28, 2001, the START-2 attempted to locate the King Tut Mine (Appendix C; Team 3, Page 34). The START-2 followed the Forest Service Road where the mine was located on a topographic map. Upon arrival, there were no visible signs of the King Tut Mine (Appendix A; Photo 8-19). No samples were collected.

6.21 RED TOP MINE

6.21.1 Mine Location and Descriptions

The Red Top Mine is a former lead and zinc mine located in the Metaline mining district (Derkey 1990). The legal description of the property is Sections 1 and 2, Township 40N, Range 44E, Pend Oreille County, Washington. The mine is reported to have produced 5 tons of crude lead ore (Derkey 1990). The deposit is in silicified dolomite and has been exposed in open cuts for 1,500 feet along the strike (Derkey 1990).

6.21.2 START-2 Mine Visit

One June 28, 2001, the START-2 attempted to locate the Red Top Mine (Appendix C; Team 3, Page 34). The START-2 followed the Forest Service Road where the mine was located on a topographic map. Upon arrival, there were no visible signs of the Red Top Mine (Appendix A; Photo 8-20). No samples were collected.

Table 6-1

BLUE BUCKET MINE SEDIMENT SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264075	01264267	01264269
CLP Inorganic ID	MJ0BQ7	MJ0F16	MJ0F14
CLP Organic ID	JX832	J0F16	J0F14
E & E Sample ID	NU	01050280	01050279
Station Location	US004SD	BBPP01SD	BBPP02SD
Depth (in. bgs)	0 - 2	0 - 8	0 - 8
Description	Background	PPE	
TAL Metals (mg/kg)			
Aluminum	**7950**	**3640**	**6760**
Arsenic	**2.6**	3.6 U	9.1 U
Barium	**68.4**	**59.0**	**114**
Cadmium	**0.38 JK (0.54 AC)**	**1.7**	**2.8**
Calcium	**1520 JK (1946 AC)**	**70500**	**35400**
Chromium	**14.1**	**6.5**	**11.9**
Copper	**12.7 JK**	**8.9 JL**	**23.0 JL**
Iron	**13600**	**9540**	**12000**
Lead	**14.8**	**59.9**	**72.5**
Magnesium	**3290**	**32200**	**8730**
Manganese	**699**	**341**	**194**
Nickel	**20.3**	**17.3**	**44.9**
Zinc	**54.7**	**329 JH (219 AC)**	**560 JH (373 AC)**
Total Organic Carbon (mg/kg)			
TOC	**19000**	**3530**	**56300**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample result is significant as defined in Section 5.

Key:

AC	= Adjusted concentration.
B	= The reported concentration is between the instrument detection limit and the contract required detection limit.
BB	= Blue Bucket Mine.
bgs	= below ground surface.
BK	= Background.
CLP	= Contract Laboratory Program.
E&E	= Ecology and Environment, Inc.
EPA	= United States Environmental Protection Agency.
H	= High bias.
ID	= Identification.
in.	= inches.
J	= The analyte was positively identified. The associated numerical value is an estimate.
L	= Low bias.
mg/kg	= milligrams per kilogram.
PPE	= probable point of entry.
PR	= Pend Oreille River.
SD	= sediment.
SQL	= sample quantitation limit.
TAL	= target analyte list.
TOC	= Total organic carbon.
U	= The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 6-2

ORIOLE MINE SEDIMENT SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264075	01264272	01264273
CLP Inorganic ID	MJ0BQ7	MJ0F18	MJ0F19
CLP Organic ID	JX832	J0F18	J0F19
E & E Sample ID	NU	01050274	01050273
Station Location	US004SD	ORSP01SD	ORSP02SD
Depth (in. bgs)	0 - 2	0 - 8	0 - 8
Description	Background	Source	
TAL Metals (mg/kg)			
Aluminum	**7950**	**5190**	**9280**
Arsenic	**2.6**	**4.6**	**13.8**
Barium	**68.4**	**234**	**123**
Cadmium	0.38 JBK (0.54 SQL)	**8.5**	**27**
Calcium	**1520 JK**	**65000**	**51900**
Chromium	**14.1**	**14.2**	**14.8**
Copper	**12.7JK (15.5 AC)**	**32.3 JL**	**71.7 JL**
Iron	**13600**	**7680**	**20900**
Lead	**14.8**	**301**	**714**
Magnesium	**3290**	**36400**	**33200**
Manganese	**699**	**4210**	**2230**
Nickel	**20.3**	**15.7**	**21.1**
Silver	0.60 UJL (1.0 U AC)	**2.8**	**5.6**
Zinc	**54.7**	**784**	**5740**
Total Organic Carbon (mg/kg)			
TOC	**19000**	**19500**	**19200**

Note:

Key:

AC	= Adjusted concentration.
B	= The reported concentration is between the instrument detection limit and the contract requited detection li
bgs	= below ground surface.
BK	= background.
CLP	= Contract Laboratory Program.
E&E	= Ecology and Environment, Inc.
EPA	= United States Environmental Protection Agency.
ID	= Identification.
in.	= inches.
J	= The analyte was positively identified. The associated numerical value is an estimate.
L	= Low bias.
mg/kg	= milligrams per kilogram.
NU	= Not utilized.
OR	= Oriole Mine.
PR	= Pend Oreille River.
SD	= sediment.
SP	= spring.
SQL	= Sample quantitation limit.
TAL	= target analyte list.
US	= tributary sediment/soil (upstream/upland sampling location.

Table 6-3

JOSEPHINE MINE SURFACE WATER SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER
MINES AND MILLS
PRELIMINARY ASSESSMENTS AND
SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264419	01264356
CLP Inorganic ID	MJ0GM8	MJ0FK9
CLP Organic ID	NU	NU
E & E Sample ID	NU	NU
Station Location	POBK01SW	JOSP01SW
Description	Background	Source
TAL Metals (µg/L)		
Calcium	**18700**	**137000**
Lead	2.8 U	**<u>21.5</u>**
Magnesium	4950 JB	**46400**
Zinc	2.8 JB (20 SQL)	**<u>117</u>**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample result is significant as defined in Section 5.

Key:

B = The reported concentration is between the instrument detection limit and the contract required detection limit.
BK = background.
CLP = Contract Laboratory Program.
E&E = Ecology and Environment, Inc.
EPA = United States Environmental Protection Agency.
ID = identification.
J = The analyte was positively identified. The associated numerical value is an estimate.
JO = Josephine Mine.
µg/L = micrograms per liter.
NU = Not utilized.
PO = Pend Oreille Mine/Mill.
SP = spring.
SQL = sample quantitation limit.
SW = surface water.
TAL = target analyte list.
U = The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 6-4

JOSEPHINE MINE SEDIMENT SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER
MINES AND MILLS
PRELIMINARY ASSESSMENTS AND
SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264420	01264423
CLP Inorganic ID	MJ0GM9	MJ0GN2
CLP Organic ID	J0GM9	J0GN2
E & E Sample ID	01050244	01050247
Station Location	POBK01SD	JOPP01SD
Depth (in. bgs)	0 - 8	0 - 8
Description	Background	PPE
TAL Metals (mg/kg)		
Aluminum	**11100**	**213**
Arsenic	**16.3**	**6.7**
Barium	**183**	31.6 JB
Cadmium	0.57 JB (0.57 SQL)	**9.6**
Calcium	**21500**	**290000**
Chromium	**17.6**	0.86 U
Copper	**25.9 JL (31.6 AC)**	**6.6 JL**
Iron	**27000**	**807**
Lead	**35.7**	**17400**
Magnesium	**8910**	**10800**
Manganese	**921**	**79.3**
Mercury	0.10 U	**0.16**
Nickel	**20.9**	5.0 JB
Silver	1.4 U	**2.3**
Vanadium	**28.3**	8.6 JB
Zinc	**287**	**2040**
Total Organic Carbon (mg/kg)		
TOC	**13700**	**36100**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample result is significant as defined in Section 5.

Key.

AC	= Adjusted concentration.
B	= The reported concentration is between the instrument detection limit and the contract required detection limit.
bgs	= below ground surface.
BK	= background.
CLP	= Contract Laboratory Program.
E&E	= Ecology and Environment, Inc.
EPA	= United States Environmental Protection Agency.
ID	= Identification.
in.	= inches.
J	= The analyte was positively identified. The associated numerical value is an estimate.
JO	= Josephine Mine.
L	= Low bias.
mg/kg	= milligrams per kilogram.
PO	= Pend Oreille Mine/Mill.
PPE	= probable point of entry.
SD	= sediment.
SQL	= Sample quantitation limit.
TAL	= Target analyte list.
TOC	= Total organic carbon.
U	= The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 6-5

GRANDVIEW MINE/MILL SURFACE WATER SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER
MINES AND MILLS
PRELIMINARY ASSESSMENTS AND
SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264419	01264415	01264417
CLP Inorganic ID	MJ0GM8	MJ0GM4	MJ0GM6
CLP Organic ID	NU	NU	NU
E & E Sample ID	NU	NU	NU
Station Location	POBK01SW	GMPP04SW	GMPP05SW
Description	Background	PPE	
TAL Metals (µg/L)			
Aluminum	104 JB	156 JB	**245**
Calcium	**18700**	**18300**	**18800**
Iron	53.7 U	**103**	**273**
Lead	2.8 U	2.8 U	**4.1**
Magnesium	4950 JB	4840 JB	**5020**
Manganese	7.7 JB (15 SQL)	11.1 JB	**25.5**
Zinc	2.8 JB (20 SQL)	5.5 JB	**20.6**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample result is significant as defined in Section 5.

Key:

B	= The reported concentration is between the instrument detection limit and the contract required detection limit.
BK	= background.
CLP	= Contract Laboratory Program.
E&E	= Ecology and Environment, Inc.
EPA	= United States Environmental Protection Agency.
GM	= Grandview Mine/Mill.
ID	= Identificaiton.
J	= The analyte was positively identified. The associated numerical value is an estimate.
µg/L	= micrograms per liter.
NU	= Not utilized.
PO	= Pend Oreille Mine/Mill.
PPE	= probable point of entry.
SQL	= sample quantitation limit.
SW	= surface water.
TAL	= Target analyte list.
U	= The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 6-6

GRANDVIEW MINE/MILL SEDIMENT SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER
MINES AND MILLS
PRELIMINARY ASSESSMENTS AND
SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264420	01264416	01264418
CLP Inorganic ID	MJ0GM9	MJ0GM5	MJ0GM7
CLP Organic ID	J0GM9	J0GM5	JOGM7
E & E Sample ID	01050244	01050242	01050243
Station Location	POBK01SD	GMPP04SD	GMPP05SD
Depth (in. bgs)	0 - 8	0 - 8	0 - 8
Description	Background	PPE	
TAL Metals (mg/kg)			
Aluminum	**11100**	**3160**	**8400**
Arsenic	**16.3**	**4.5**	**5.2**
Barium	**183**	**44.6**	**110**
Cadmium	0.57 JB (0.57 SQL)	0.34 U	**1.6**
Calcium	**21500**	**27500 JL**	**14600**
Chromium	**17.6**	**7.1**	**25.5**
Copper	**25.9 JL (31.6 AC)**	**8.1**	**84.0 JL**
Iron	**27000**	**7810**	**16600**
Lead	**35.7**	**43.5**	**449**
Magnesium	**8910**	**15000 JL**	**10400**
Manganese	**921**	**209 JH (169 AC)**	**313**
Nickel	**20.9**	5.9 JB	**12.3**
Potassium	2020 JB	427 JB	**1560**
Vanadium	**28.3**	9.3 JB	**20.1**
Zinc	**287**	**152**	**864**
Total Organic Carbon (mg/kg)			
TOC	**18800**	**8670**	**10200**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample results is significant as defined in Section 5.

Key:
AC = adjusted concentration.
B = The reported concentration is between the instrument detection limit and the contract required detection limit.
bgs = below ground surface.
BK = background.
CLP = Contract Laboratory Program.
E&E = Ecology and Environment, Inc.
EPA = United States Environmental Protection Agency.
GM = Grandview Mine/Mill.
H = high bias.
ID = Identification.
in. = inches.
J = The analyte was positively identified. The associated numerical value is an estimate.
L = low bias.
mg/kg = milligrams per kilogram.
PO = Pend Oreille Mine/Mill.
PPE = probable point of entry.
SD = sediment.
SQL = sample quantitation limit.
TAL = Target analyte list.
TOC = Total organic carbon.
U = The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 6-7

PEND OREILLE MINE/MILL SURFACE SOIL SAMPLES ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264358	01264274	01264252	01264253	01264254	01264255	01264256	01264257	01264258	01264259	01264260	01264353	01264354	01264355
CLP Inorganic ID	MJ0FL1	MJ0F20	MJ0EZ7	MJ0EZ8	MJ0EZ9	MJ0F00	MJ0F01	MJ0F02	MJ0F03	MJ0F04	MJ0F05	MJ0FK6	MJ0FK7	MJ0FK8
CLP Organic ID	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU
E & E Sample ID	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU	NU
Station Location	BK02SS	BK03SS	POTP01SS	POTP02SS	POTP03SS	POTP04SS	POTP05SS	POTP06SS	POTO07SS	POTP08SS	POTP09SS	POWP01SS	POWP02SS	POWP03SS
Depth (in. bgs)	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6
Description	Background		TDF-1/Source			TDF-3/Source			TDF-2/Source			Source		
TAL Metals (mg/kg)														
Aluminum	**13500**	**12900**	**325**	**8080**	**4680**	**146**	**312**	**243**	**614**	**293**	**222**	**1570**	**750**	**848**
Arsenic	**3.5**	**6.7**	**20.6**	5.1 U	**18.9**	**19.8**	**40.0**	**20.8**	**26.4**	**22.4**	**21.1**	**18.4**	**21.8**	**35.1**
Barium	**296**	**374**	20.3 JB	**71.1**	**70.4**	8.7 JB	7.8 JB	10.0 JB	15.7 JB	10.2 JB	8.9 JB	**47.1**	20.2 JB	29.5 JB
Cadmium	0.86 JB (0.86 SQL)	1.2 JB (1.2 SQL)	**15.0**	0.08 U	**9.2**	**8.5**	**8.2**	**11.9**	**30.4**	**20.1**	**10.4**	**4.0**	**34.2**	**44.1**
Calcium	**19100 JL**	**2460**	**182000**	**16900**	**94100**	**152000**	**117000**	**148000**	**159000**	**156000**	**158000**	**262000 JL**	**190000 JL**	**195000 JL**
Chromium	**22.6**	**12.9**	**10.4**	**19.2**	**13.9**	**3.9**	**2.7**	**7.1**	**14.3**	**8.0**	**7.2**	**3.9**	2.0 JB	**2.8**
Copper	**17.0 JL (20.7 AC)**	**19.7 JL (24.0 AC)**	**176 JL**	**27.6 JL**	**58.3 JL**	**90.0 JL**	**40.3 JL**	**178 JL**	**242 JL**	**113 JL**	**88.0 JL**	**21.2 JL**	**9.2 JL**	**10.8 JL**
Iron	**18100**	**16700**	**32000**	**15900**	**37800**	**62700**	**171000**	**60800**	**61800**	**61100**	**56000**	**4220**	**12400**	**8510**
Lead	**47.2 JK (68 AC)**	**22.3**	**680**	**9.5**	**467**	**666**	**1650**	**818**	**1760**	**1000**	**919**	**3010 JK (2090 AC)**	**8100 JK (5625 AC)**	**6030 JK (4188 AC)**
Magnesium	**3870 JK**	**4360**	**74300**	**8460**	**42300**	**97400**	**70800**	**91800**	**69200**	**81800**	**73300**	**31000 JK**	**68500 JK**	**62400 JK**
Manganese	**989**	**4050**	**228**	**310**	**279**	**220**	**214**	**236**	**217**	**208**	**184**	**105**	**194**	**196**
Mercury	0.06 U	0.06 U	**0.25**	0.07 U	**0.16**	**0.15**	**0.10**	**0.18**	**0.58**	**0.25**	**0.16**	0.05 U	**0.16**	**0.19**
Nickel	**18.9**	**19.4**	9.6 JB	**18.9**	**15.1**	**20.0**	**21.4**	**16.6**	**16.1**	**13.7**	**13.7**	**73.9**	**20.9**	**33.6**
Potassium	**2250**	644 JB	195 JB	1340 JB	665 JB	74.3 JB	87.7 JB	134 JB	336 JB	156 JB	145 JB	985 JB	303 JB	505 JB
Selenium	0.84 U	0.83 U	0.83 U	0.94 U	0.9 U	0.78 U	0.71 U	0.87 U	0.90 U	0.82 U	0.80 U	**3.1**	0.70 U	**1.7**
Silver	0.68 JB (0.68 SQL)	0.92 JB (0.92 SQL)	0.65 JB	0.68 JB	1.1 JB	0.98 JB	**2.3**	1.3 JB	1.3 JB	1.1 JB	0.92 JB	0.54 JB	0.93 JB	0.73 JB
Vanadium	**35.2**	**17.9**	7.2 JB	**36.3**	**24.0**	3.7 JB	5.1 JB	9.0 JB	11.0 JB	7.6 JB	7.6 JB	**43.8**	**18.4**	**36.0**
Zinc	**201**	**115**	**4130 JH (2753 AC)**	**67.6 JH (45.1 AC)**	**2190 JH (1460 AC)**	**1590 JH (1060 AC)**	**2500 JH (1667 AC)**	**2520 JH (1680 AC)**	**6540 JH (4360 AC)**	**4540 JH (3027 AC)**	**2270 JH (1513 AC)**	**890**	**7420**	**9300**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample result is significant as defiend in Section 5.

Key:

AC	= Adjsuted concentration.
B	= The reported concentration is between the instrument detection limit and the contract required detection limit.
bgs	= below ground surface.
BK	= background.
CLP	= Contract Laboratory Program.
E&E	= Ecology and Environment, Inc.
EPA	= United States Environmental Protection Agency.
H	= High bias.
ID	= Identification.
in.	= inches.
J	= The analyte was positively identified. The associated numerical value is an estimate.
K	= Unknown bias.
L	= Low bias.
mg/kg	= milligrams per kilogram.
NU	= Not utilized.
PO	= Pend Oreille Mine/Mill.
SQL	= sample quantitation limit.
SS	= surface soil.
TAL	= Target analyte list.
TDF	= Tailings disposal facility.
TP	= tailings pile.
U	= The analyte was not detected. The associated numerical value is the contract required detection limit.
WP	= waste rock pile.

Table 6-8

PEND OREILLE MINE/MILL SURFACE WATER SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER
MINES AND MILLS
PRELIMINARY ASSESSMENTS AND
SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264419	01264401	01264410	01264412
CLP Inorganic ID	MJ0GM8	MJOGL0	MJ0GL9	MJ0GM1
CLP Organic ID	NU	NU	NU	NU
E & E Sample ID	NU	NU	NU	NU
Station Location	POBK01SW	POPP01SW	POPP02SW	POPP03SW
Description	Background	PPE		
TAL Metals (µg/L)				
Barium	57.3 JB (200 SQL)	71.6 JB	58.5 JB	**62.6**
Calcium	**18700**	**48500**	**89400**	**20100**
Iron	53.7 U	71.3 U	**409**	**107**
Lead	2.8 U	**8.7**	**9.3**	2.8 U
Magnesium	4950 JB	**30200**	**29000**	**5230**
Manganese	7.7 JB (15 SQL)	0.43 JB	**33.0**	10 JB
Zinc	2.8 JB (20 SQL)	**212**	**62.5**	4.4 JB

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample results is significant as defined in Section 5.

Key:

B = The reported concentration is between the instrument detection limit and the contract required detection limit.
BK = Background.
CLP = Contract Laboratory Program.
E&E = Ecology and Environment, Inc.
EPA = United States Environmental Protection Agency.
ID = Identification.
J = The analyte was positively identified. The associated numerical value is an estimate.
µg/L = micrograms per liter.
NU = Not utilized.
PO = Pend Oreille Mine/Mill.
PPE = probable point of entry.
SQL = sample quantitation limit.
SW = surface water.
TAL = Target analyte list.
U = The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 6-9

PEND OREILLE MINE/MILL SEDIMENT SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER
MINES AND MILLS
PRELIMNARY ASSESSMENTS AND
SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264420	01264411	01264413
CLP Inorganic ID	MJ0GM9	MJ0GM0	MJ0GM2
CLP Organic ID	J0GM9	J0GM0	J0GM2
E & E Sample ID	01050244	01050239	01050240
Station Location	POBK01SD	POPP02SD	POPP03SD
Depth (in. bgs)	0 - 8	0 - 8	0 - 8
Description	Background	PPE	
TAL Metals (mg/kg)			
Aluminum	**11100**	**3310**	**4250**
Arsenic	**16.3**	**13.1**	**3.2**
Barium	**183**	**250**	44.7 JB
Cadmium	0.57 JB (0.57 SQL)	**6.1**	0.27 U
Calcium	**21500**	**209000 JL**	**8600 JL**
Chromium	**17.6**	**9.2**	**6.0**
Copper	**25.9 JL (31.6 AC)**	**28.4**	**24.4**
Iron	**27000**	**31100**	**9160**
Lead	**35.7**	**346**	**23.6**
Magnesium	**8910**	**42200 JL**	**5930 JL**
Manganese	**921**	**1970 JH (1589 AC)**	**160 JH (129 AC)**
Nickel	**20.9**	**40.4**	7.8 JB
Vanadium	**28.3**	12.2 JB	**15.4**
Zinc	**287**	**2370**	**160**
Total Organic Carbon (mg/kg)			
TOC	**18800**	**46100**	**541 J**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample result is significant as defined in Section 5.

Key:
AC = adjusted concentration.
B = The reported concentration is between the instrument detection limit and the contract required detection limit.
bgs = below ground surface.
BK = background.
CLP = Contract Laboratory Program.
E&E = Ecology and Environment, Inc.
EPA = United States Environmental Protection Agency.
H = High bias.
ID = Identification.
in. = inches.
J = The analyte was positively identified. The associated numerical value is an estimate.
L = Low bias.
mg/kg = milligrams per kilogram.
PO = Pend Oreille Mine/Mill.
PPE = probable point of entry.
SD = sediment.
SQL = sample quantitation limit.
TAL = Target analyte list.
TOC = Total organic carbon.
U = The analyte was not detected. The associated numerical value is the contract required detection limit.

7. EPA CLP ANALYTICAL RESULTS, SURFACE WATER MIGRATION/EXPOSURE PATHWAYS, AND TARGETS

The following sections describe the surface water migration pathway for the 5 mines/mills that were sampled; namely Blue Bucket Mine, Oriole Mine, Josephine Mine, Grandview Mine/Mill, and Pend Oreille Mine/Mill; tributaries that were sampled; potential targets within the range of influence of these mines/mills (Figures 7-2 through 7-6); and a discussion of sample results evaluated in accordance with criteria described in Section 5.1. Analytical data forms from laboratory analyses are provided in Appendix D.

An evaluation of the groundwater migration, soil exposure and air migration pathways for the Blue Bucket Mine, Oriole Mine, Josephine Mine, and Pend Oreille Mine/Mill was not conducted as part of this investigation. An evaluation of these pathways was conducted for the Grandview Mine/Mill site and can be found in the Grandview Mine PA/SI report prepared by E & E for EPA, dated June 2001.

A description of the groundwater migration, soil exposure and air migration pathways was prepared for the Pend Oreille Mine/Mill site with conditions observed as of May 2000. This information can be found in the Pend Oreille Mine Preliminary Assessment report prepared by E & E for EPA, dated November 2000.

Refer to Table 7-1 for PPEs of each sampled mine/mill.

7.1 BLUE BUCKET MINE

7.1.1 Surface Water Pathway Description

The potential source area at the Blue Bucket Mine includes a waste rock pile measuring approximately 60 feet long by 50 feet wide by 15 feet deep. The distance from the waste rock pile to a nearby unnamed creek is approximately 30 feet. Potential flow from a shaft on the property to the unnamed creek is approximately 5 feet (Figure 6-2, Table 7-1).

The START-2 estimated the flow of the unnamed creek to be 20 gpm. The average annual flow rate recorded for Pend Oreille River near Metaline Falls is 24,580 cubic feet per second (cfs; USGS 1964).

The average annual precipitation is 27.38 inches in Metaline Falls, Washington (WRCC 2001). The 2-year, 24-hour rainfall event for the area ranges from 1.8 to 2.4 inches (WRCC 2001).

Soils in the area of Blue Bucket Mine were mapped as Belzar silt loam, high precipitation, 20 to 40 percent slopes. This moderately deep, well drained soil is on the foot slopes and ridgetops of foothills and mountains. Runoff is rapid, and the hazard of water erosion is severe. (USDA 1992)

Approximately 23 upgradient acres of land is expected to drain through the source area at the mine (USGS 1992b). The drainage area of sources is approximately 80 acres (USGS 1992b).

Mines/mills adjacent and/or near the Pend Oreille River are assumed to flood at least every two years (USGS 1998a).

No containment features such as run off controls exist at the waste rock pile at the mine.

7.2 ORIOLE MINE

7.2.1 Surface Water Pathway Description

Potential source areas at the Oriole Mine include waste rock piles described in Section 6. The largest waste rock pile measured approximately 25 feet long by 15 feet wide by 4 feet deep. Flow from a nearby spring reaches the waste rock pile and continues into a muddy area with no outflow. The START-2 estimated spring flow at 32 gpm. There is a potential for overland flow from the muddy area to Linton Creek during periods of heavy rainfall or snowmelt, and floods (Figure 6-4, Table 7-1). Linton Creek, a tributary to the Pend Oreille River, is located north of Metaline Falls. It is located on the west side of the Pend Oreille River approximately 1 mile upstream from Metaline Falls and 11 miles upstream from Boundary Dam with an estimated flow of 2 cfs (Ecology 2001b).

The average annual flow rate recorded for Pend Oreille River near Metaline Falls is 24,580 cfs (USGS 1964).

The average annual precipitation is 27.38 inches in Metaline Falls, Washington (WRCC 2001). The 2-year, 24-hour rainfall event for the area ranges from 1.8 to 2.4 inches (WRCC 2001).

Soils in the vicinity of Oriole Mine were mapped as Belzar, high precipitation-Rock outcrop complex, 5 to 40 percent slopes. Runoff is rapid, and the hazard of water erosion is severe. (USDA 1992)

Approximately 80 upgradient acres of land is expected to drain through the source area at the mine (USGS 1984). The drainage area of sources is approximately 43 acres (USGS 1984).

Mines/mills adjacent and/or near the Pend Oreille River are assumed to flood at least every two years (USGS 1998a).

No containment features such as run off controls exist at waste rock piles at the mine.

7.3 JOSEPHINE MINE

7.3.1 Surface Water Pathway Description

The potential source area at the Josephine Mine is a waste rock pile measuring approximately 60 feet long by 10 feet high by 2 feet deep. The entire length of the waste rock pile extends into the Pend Oreille River (Figure 6-6, Table 7-1).

The average annual flow rate recorded for Pend Oreille River near Metaline Falls is 24,580 cfs (USGS 1964).

The average annual precipitation is 27.38 inches in Metaline Falls, Washington (WRCC 2001). The 2-year, 24-hour rainfall event for the area ranges from 1.8 to 2.4 inches (WRCC 2001).

Soils in the vicinity of Josephine Mine were mapped as Belzar silt loam, high precipitation, 20 to 40 percent slopes. This moderately deep, well drained soil is on the foot slopes and ridgetops of foothills and mountains. Runoff is rapid, and the hazard of water erosion is severe. (USDA 1992)

Approximately 4 upgradient acres of land is expected to drain through the source area at the mine (USGS 1992a). The drainage area of sources is approximately 23 acres (USGS 1992a).

Mines/mills adjacent and/or near the Pend Oreille River are assumed to flood at least every two years (USGS 1998a).

No containment features such as run off controls exist at waste rock piles at the mine.

7.4 GRANDVIEW MINE/MILL

7.4.1 Surface Water Pathway Description

The site is located approximately 0.75 mile east of Pend Oreille River. Site topography slopes gently toward Pend Oreille River. The site consists of two main levels. The lower level appeared to be the mill operational area and the upper area appeared to be the mine operational area. The two main levels are relatively flat with a slope between them. There is another slope between the lower level and the suspected tailings pile, which slopes gently toward Pend Oreille River. The nearest potential source area at the site to the river is the suspected tailings pile. From this source area, it is approximately 300 feet overland to Pend Oreille River (Figure 6-12, Table 7-1). From this PPE in Pend Oreille River, it is approximately 8 miles to Boundary Dam.

The average annual flow rate recorded for Pend Oreille River near Metaline Falls is 24,580 cfs (USGS 1964).

The average annual precipitation is 27.38 inches in Metaline Falls, Washington (WRCC 2001). The 2-year, 24-hour rainfall event for the area ranges from 1.8 to 2.4 inches (WRCC 2001).

Runoff is medium, and the hazard of water erosion is moderate. (USDA 1992)

Approximately 4 upgradient acres of land are expected to drain through a source area at the site (USGS 1992a). The drainage area of sources is approximately 33 acres (USGS 1992a).

Mines/mills adjacent and/or near the Pend Oreille River are assumed to flood at least every two years (USGS 1998a).

No containment features such as run off control exist at the contaminant sources at the site.

7.5 PEND OREILLE MINE/MILL

7.5.1 Surface Water Pathway Description

Surface water resources in the vicinity of the Pend Oreille Mine/Mill include the Pend Oreille River, creeks that transect the mineralized areas of the Metaline District and provide water to the river, and lakes that are usually found within the glacial sediments and are frequently associated with wetlands. Potential source areas at the site include mine water discharge into the Pend Oreille River, three TDFs, and one waste rock pile. A description of overland flow from source areas at the site to associated PPEs is provided in Table 7-1. PPE locations are shown in Figure 6-12.

Surface water flows are generated from precipitation in the form of rainfall or snowfall, and where groundwater is exposed at the surface.

Several creeks transect the site. Threemile Creek, which flows year-round and has flow rates of a few hundred gpm or higher depending on the time of year, is located near the northern border of the mine/mill and adjacent to USFS-managed lands. Threemile Creek is primarily confined to a single channel along most of its length within the mine/mill area, and dorms a large forested wetland used by beavers near the northeastern boundary of the mine/mill. (Ecology 2000)

Two creeks are found near the TDF-1. One creek (Creek 1) originates to the east of the mine/mill, near the golf course. Water flows within a well-defined channel along most of its length during most of the year and empties into Pend Oreille River. (Figure 6-12; Ecology 2000)

Two seep areas are located by TDF-2 and TDF-3. The water in these seeps appear to originate from hill slopes and from TDF-2. This seepage is collected in diversion channels and routed around and to the base of TDF-1, where it meets with natural seepage. This water then flows downslope (Creek 2) and drains into Pend Oreille River (PPE 2). Surface water runoff from TDF-1 and TDF-2 drains into installed diversion ditches which drain into Pend Oreille River. (Figure 6-12, Ecology 2000)

A third unnamed creek (Creek 3) originates off the property east of the 9th/18th fairway of the Metaline Falls Golf Course. It flows approximately 160 feet through a wetland on the edge of the fairway, and for an additional 150 feet on the fairway before flowing underground. (Ecology 2000)

Frog Creek originates approximately 900 feet downslope from TDF-3 as a groundwater spring and seep. Frog Creek derives its water from groundwater flowing beneath the kettle basin that holds TDF-3 and from precipitation; it has a perennial flow. Initially, water from the spring flows into several channels, which then join into a single channel approximately 400 feet downstream from the source. This channel flows downhill until it intersects an access road that leads to TDF-1, then flows northerly along this road, and then westerly under the road into a small pond. The flow rate is estimated by Ecology to be 40 gpm. The creek flows from the pond in a northwesterly direction until surface flow terminates approximately 100 feet downslope from the pond. The creek resurfaces approximately 50 feet downslope from the southern mine/mill access road that parallels Pend Oreille River. The water collects into two channels and eventually flows into Pend Oreille River. (Figure 6-12, Ecology 2000)

Flume and Beaver creeks are important tributaries of Pend Oreille River that drain into the river from the west and are also near the site (Figure 6-12). Surface water runoff from the staged waste rock may drain by sheet flow into Flume Creek which drains into Pend Oreille River.

Each of the PPEs described in this section are located along the Pend Oreille River. Approximately 8 miles of the 15-mile target distance limit (TDL) are on the Pend Oreille River between the PPEs on site and Boundary Dam; 1 mile covers the final section of the Pend Oreille River from Boundary Dam to the Canadian border; and the remaining 6 miles are on the Pend Oreille River in Canada (Figure 6-11).

The average annual flow rate recorded for Pend Oreille River near Metaline Falls is 24,580 cfs (USGS 1964).

The average annual precipitation is 27.38 inches in Metaline Falls, Washington (WRCC 2001). The 2-year, 24-hour rainfall event for the area ranges from 1.8 to 2.4 inches (WRCC 2001).

Approximately 13,698 upgradient acres of land are expected to drain through a source area at the site (USGS various dates). The drainage area for the waste rock pile at the site is estimated to be 64 acres (USGS various dates).

Mines/mills adjacent and/or near the Pend Oreille River are assumed to flood at least every two years (USGS 1998a).

7.6 TRIBUTARIES

Tributaries to the lower Pend Oreille River sampled as part of this field effort include Linton Creek, Sullivan Creek, Flume Creek, Beaver Creek, Slate Creek, Ledbetter Creek, Everett Creek, an unnamed tributary, Lime Creek, and Pewee Creek (Figure 6-12). Sample results are summarized in Table 7-5.

Linton Creek is located on the west side of the Pend Oreille River 1 mile upstream from Metaline Falls and approximately 11 miles upstream from Boundary Dam with an estimated flow of 2 cfs (Ecology 2001b). Sullivan Creek is located on the east side of the Pend Oreille River approximately ½ mile downstream from Metaline Falls and 9 miles upstream from Boundary Dam with an estimated flow less than 10 cfs on the North Fork of Sullivan Creek and an estimated flow between 30 and 170 cfs on Sullivan Creek (Ecology 2001b). Flume Creek is located on the west side of the Pend Oreille River approximately 1 mile downstream from Metaline Falls and 8 miles upstream from Boundary Dam with an estimated flow between 5 and 35 cfs (Ecology 2001b). Beaver Creek is located on the west side of the Pend Oreille River approximately 2 miles downstream from Metaline Falls and 7 miles upstream from Boundary Dam. Slate Creek is located on the east side of the Pend Oreille River approximately 4 miles downstream from Metaline Falls and 5 miles upstream from Boundary Dam. Ledbetter Creek is located on the west side of the Pend Oreille River approximately 5 miles downstream from Metaline Falls and 4 miles upstream from Boundary Dam. Everett Creek is located on the west side of the Pend Oreille River approximately 5 miles downstream from Metaline Falls and 4 miles upstream from Boundary Dam. The unnamed tributary is located on the east side of the Pend Oreille River approximately 7 miles downstream from Metaline Falls and 3 miles upstream from Boundary Dam. Lime Creek is located on the east side of the Pend Oreille River approximately 7 miles downstream from Metaline Falls and 1 mile upstream from Boundary Dam. Pewee Creek is located on the west side of the Pend Oreille River approximately 9 miles downstream from Metaline Falls and 1 mile upstream from Boundary Dam.

7.7 TARGETS

This section discusses potential target information for the 5 mines that were sampled; namely, Blue Bucket Mine, Oriole Mine, Josephine Mine, Grandview Mine/Mill, and the Pend Oreille Mine/Mill.

The Clark-Fork/Pend Oreille Basin is characterized by highly valued recreational and economic resources and is the central focus of nearly every major urban, industrial, and agricultural activity in the region. Vast resources of minerals, timber, fish, wildlife, water, rangeland, and croplands support a variety of human uses, ranging from mining and agriculture to recreational fishing and boating. (EPA 1993)

Surface water intakes are reported to lie within the surface water TDL for each of the mines/mills sampled. Refer to Table 7-2 for surface water intakes for each mine/mill. The average number of persons per household in Metaline Falls is 1.49 (USBC 2000); therefore, the START-2 estimates the following:

- There are 2.98 persons using surface water for drinking water within the 15-mile TDL of Blue Bucket Mine;
- There are 2.98 persons using surface water for drinking water within the 15-mile TDL of Oriole Mine;
- There are no persons using surface water for drinking water within the 15-mile TDL of Josephine Mine;
- There are no persons using surface water for drinking water within the 15-mile TDL of Grandview Mine/Mill; and
- There are no persons using surface water for drinking water within the 15-mile TDL of Pend Oreille Mine/Mill. (Ecology 2001a)

The START-2 expects that surface water will be used within the TDL for irrigation of commercial food or forage crops or for watering of commercial livestock.

Fishing occurs on Pend Oreille River; however, the river is relatively underutilized with respect to fisheries (BLM 2001). Boundary Dam notes that visitors can fish for rainbow trout as they drift down the river in a raft or boat (BLM 2001). Seattle City Light is promoting tourism with www.cityofseattle.net/light/tours/boundary (Baker 2001). Fishing around Box Canyon Dam has been documented; however, fish catch data are not available. The area contains trout, perch, catfish, but no steelhead or salmon (Owens 2001).

Most of the fishing that occurs on the Pend Oreille River is by local residents, and is concentrated at the mouth of major tributaries such as Flume, Sullivan, and Slate creeks. Some boating occurs on the river adjacent to the mine/mill areas. Rafting, innertubing, swimming, jetskiing, and waterskiing occur predominantly upstream from the 5 mines/mills that were sampled between Box Canyon Dam and Metaline Falls. A privately-conducted jet-boat tour of the Pend Oreille River from Box Canyon to Boundary Dam which passes by the 5 mines/mills runs approximately four days each week during late spring, summer, and early fall tourist season. At present, the only boat launches along this stretch of the Pend Oreille River are in Metaline and at the Boundary Dam (Ecology 2000).

One fish species present in the lower Pend Oreille River has been listed as threatened by the federal government; bull trout (*Salvelinus confluentus*), a Federal listed threatened species found in the Columbia River basin distinct population segment, was listed as a threatened species by the United States Fish and Wildlife Service on June 10, 1998. One bird species present in the lower Pend Oreille River has been listed

as threatened or endangered by the state or federal government. The American peregrine falcon (*Falco peregrinus anatum*; a State listed endangered species) typically lives along mountain ranges, river valleys, and coastlines. Peregrine falcons may occasionally fly along Pend Oreille River near the 5 mines/mills that were sampled. (Ecology 2000)

Five mammal species in the vicinity of the 5 mines/mills have been listed as threatened or endangered by the state or federal government. Gray wolves (*Canis lupus*; a Federal listed endangered species) have been sighted and their presence confirmed in the Colville National Forest, although these are likely lone dispersing wolves. Camera surveillance has not detected wolves, and no systematic surveys for wolves have been conducted. Grizzly bears (*Ursus arctos*; a Federal listed threatened and State listed endangered species) are present throughout the Colville National Forest, although the number of bears is lower near Lake Sullivan and the 5 mines/mills that were sampled. A grizzly bear den has been found on the Colville National Forest, east of the Pend Oreille Mine/Mill near the Idaho border, and grizzly bears have been radio-located on both sides of the Pend Oreille River. The Pend Oreille Mine/Mill is adjacent to a designated grizzly bear recovery area, which begins east of State Route 31. The North American (Canada) lynx (*Lynx canadensis*; a proposed Federal listed threatened or endangered and State listed threatened species) may travel through the 5 mines/mills areas; tracks of lynx were found in the Slate Creek drainage in 1978. The Pacific fisher (*Martes pennanti pacifica*; a Federal listed species of concern and State listed endangered species) is a large, weasel-like animal. There have been unconfirmed sightings in the 5 mine/mill areas, and it is believed that the fisher may be present around Sullivan and Slate creeks, as well as Sullivan Lake. The woodland (mountain) caribou (*Rangifer tarandus caribou*; a Federal and State listed endangered species) could potentially enter the 5 mine/mill areas, but all woodland caribou that have been previously signted on or near the Pend Oreille Mine/Mill were transplanted animals that had been released nearby and were returning to the release site. There is a woodland caribou recovery area which includes mostly wilderness area east of the Pend Oreille Mine/Mill, within 25 miles south of the International Border, and further east into Idaho. (Ecology 2000)

Recreational activities that occur in the nearby Colville National Forest include hiking, camping, fishing, picnicking, mountain biking, cross-country skiing, snow shoeing, snowmobiling, horseback riding, wildlife viewing, motorized travel, and recreational gold panning and dredging. Hunting is not allowed on lands owned by Teck Cominco American Inc. (Ecology 2000).

The Salmo-Priest Wilderness Area is located approximately 3 miles east of the Pend Oreille Mine/Mill. The Wilderness Area covers 39,940 acres and is within the Colville and the Idaho Panhandle National Forests. Recreational use in this wilderness area is limited compared to other wilderness areas

within the state because of its distance from large population centers. Recreational activities that occur within the wilderness area include hunting, fishing, camping, mountain biking, wildlife viewing, and winter sports (Ecology 2000).

Farms and rural residential development are found to the east and south of the 5 mine/mill areas that were sampled. The main crops raised on agricultural lands along the Pend Oreille River are small grains and hay. Most of the agricultural land in the area originated from 160-acre plots that were homesteaded at the turn of the century. A few privately-owned farms occur in the vicinity of the Pend Oreille Mine/Mill and the other four mines/mills that were sampled. They are operated primarily for growing hay and raising cattle. Such farms are located north of the Pend Oreille Mine/Mill along Threemile Creek, east of State Route 31 opposite the mine/mill entrance, and across the Pend Oreille River north of Flume Creek. These operators also lease USFS-managed lands in close proximity to their base properties for use as summer pasture. The closest relatively high-density residential area is Pend Oreille Village, located along the river approximately 1.5 miles south of the Pend Oreille Mine/Mill. At present, the village has approximately 30 residents. The town of Metaline Falls, population 230, is located approximately 2 miles southwest of the Pend Oreille Mine/Mill. To the east of Metaline Falls is the community of Lehigh Hill, with a population of 45. Metaline is located across the river from Metaline Falls and has a population of 172. USFS-managed lands are located to the north of the 5 mine/mill areas sampled. Boating activities are common on the Pend Oreille River, especially on weekends, from the spring through the fall. (Ecology 2000)

There are no schools or day-care facilities within 200 feet of the 5 mine/mill areas that were sampled.

According to National Wetland Inventory maps:

- 0.47 linear miles of wetland frontage exists along the Pend Oreille River to the International Border for Blue Bucket Mine;
- 0.47 linear miles of wetland frontage exists along the Pend Oreille River to the International Border for Oriole Mine;
- 0.03 linear miles of wetland frontage exists along the Pend Oreille River to the International Border for Josephine Mine;
- 0.430 linear miles of wetland frontage exists along the Pend Oreille River to the International Border for Grandview Mine/Mill;
- 0.03 linear miles of wetland frontage exists along the Pend Oreille River to the International Border for Pend Oreille Mine/Mill. Wetlands were identified by Ecology at five additional locations on site:
- 1.5 acres of wetland area exists along Threemile Creek near the northeastern corner of the site,

  2 acres of artificially-created wetland area exists along the eastern side of TDF-1,

- 0.01 acre of wetland area exists between TDF-2 and TDF-1 at the base of the TDF-2 embankment,
- 0.1 acre of wetland area exists along Creek 3,
- 1.5 acres of wetland area is associated with the upper portions of Frog Creek (Figure 6-12).

Wetlands are located throughout the watershed, interspersed along the Pend Oreille River (USFWS 1987).

7.8 SAMPLE LOCATIONS

Four surface water and 20 sediment samples, including three representative background samples were collected from the lower Pend Oreille River and its tributaries and were submitted for EPA CLP analysis by E & E (Figure 7-1). This includes one sediment sample collected at the sand bar at Myers Dam and two surface water samples collected at the Metaline Falls Municipal Water Intake. The data for the aforementioned sediment and two surface water samples are found in Appendices F and G, respectively.

Two surface water samples, which includes a background, were collected on the Pend Oreille Mine/Mill property to determine whether contaminants from the tailings at the Pend Oreille Mine/Mill have impacted the unnamed creek and the lower Pend Oreille River. POCK01SW was collected north of TDF-1 and TDF-2 on the unnamed creek identified as Creek 1. This surface water sample was co-located with sediment sample POCK01SD.

Two sediment samples were collected on the Pend Oreille Mine/Mill at two springs flowing through wetlands located adjacent to TDF-1(POSP01SD and POSP02SD; Figure 6-12). The water from both springs flowed into intervention trenches which feeds into the Pend Oreille River.

Four sediment samples were collected from upstream reaches of the Pend Oreille River to determine whether contaminants from any upgradient mining sources have impacted the lower Pend Oreille River. Samples were collected at the following locations (Figure 7-1):

- The northern most point of the Pend Oreille River below the Boundary Dam (PRRS01SD);
- Upstream of Lime Creek (PRRS02SD);
- Downstream of the Pend Oreille Mine/Mill and upstream of Threemile Creek (PRRS03SD); and
- Upstream of the Pend Oreille Mine/Mill and downstream of Grandview Mine/Mill at the confluence of Flume Creek and the Pend Oreille River (PRRS04SD).

Nine sediment samples were collected from the tributaries of the Pend Oreille River, to document the distance contaminants have migrated and whether targets, such as wetlands, communities, and reservoir/lakes have been impacted. Samples were collected at the following locations (Figure 7-1):

- Upstream of the confluence of Lime Creek with the Pend Oreille River (PRTB01SD);
- Upstream of the confluence of Everett Creek with the Pend Oreille River (PRTB02SD);
- Upstream of the confluence of Ledbetter Creek with the Pend Oreille River (PRTB03SD);
- Downstream of PRTB02SD and upstream of PRTB01SD at an unnamed creek (PRTB04SD);
- Upstream of the confluence of Slate Creek with the Pend Oreille River (PRTB05SD);
- Upstream of the confluence of Pewee Creek with the Pend Oreille River (PRTB06SD);
- Upstream of the confluence of Beaver Creek with the Pend Oreille River (PRTB07SD);
- Upstream of the confluence of Sullivan Creek with the Pend Oreille River (PRTB08SD); and
- Upstream of the confluence of Linton Creek with the Pend Oreille River (PRTB09SD).

Two surface water and sediment samples were collected by Weston upstream of the confluence of Flume Creek with the Pend Oreille River (UW002SW, UW003SW, US002SD, and US003SD, respectively; Figure 7-1).

7.9 SAMPLE RESULTS

Pend Oreille Mine/Mill. Sample results are summarized in Table 7-3 and 7-4. Zinc was detected at an elevated estimated low concentration in POCK01SW (63.2 µg/L). Cadmium was detected at an elevated concentration in POCK01SD (3.5 mg/kg). Lead was detected at an elevated concentration in POCK01SD (180 mg/kg). Nickel was detected at an elevated concentration in POCK01SD (44.8 mg/kg). Vanadium was detected at an elevated concentration in POCK01SD (26.8 mg/kg). Zinc was detected at an elevated adjusted concentration in POCK01SD (217 mg/kg).

Arsenic was detected at elevated concentrations in POSP01SD (17.2 mg/kg) and POSP02SD (11.8 mg/kg). Cadmium was detected at elevated concentrations in POSP01SD (9.8 mg/kg) and POSP02SD (14.6 mg/kg). Copper was detected at an elevated estimated low concentration in POSP02SD (165 mg/kg). Lead was detected at elevated concentrations in POSP01SD (351 mg/kg) and POSP02SD(1,960 mg/kg). Mercury was detected at an elevated concentration in POSP02SD (0.39 mg/kg). Vanadium was detected at an elevated concentration in POSP02SD (20.8 mg/kg). Zinc was detected at elevated concentrations in POSP01SD (3,320 mg/kg) and POSP02SD (2,610 mg/kg).

Pend Oreille River. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment samples collected in the Pend Oreille River.

Lime Creek. Sample results are summarized in Table 7-5. Chromium was detected at an elevated concentration in PRTB01SD (57.7 mg/kg). Selenium was detected at an elevated estimated low concentration in PRTB01SD (4.9 mg/kg).

Everett Creek. Sample results are summarized in Table 7-5. Cadmium was detected at an elevated concentration in PRTB02SD (6.1 mg/kg). Chromium was detected at an elevated concentration in PRTB02SD (86.2 mg/kg).

Ledbetter Creek. Sample results are summarized in Table 7-5. "4,4'-DDT" was detected at an elevated concentration in PRTB03SD (10 mg/kg).

Unnamed Tributary. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment sample collected in the unnamed tributary.

Slate Creek. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment samples collected in Slate Creek.

Pewee Creek. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment sample collected in Pewee Creek.

Beaver Creek. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment sample collected in Beaver Creek.

Sullivan Creek. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment sample collected in Sullivan Creek.

Flume Creek. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment and surface water samples collected on Flume Creek.

Linton Creek. Sample results are summarized in Table 7-5. No analytes were detected at an elevated concentration in the sediment sample collected in Linton Creek.

Refer to Appendix E for the results of a sediment sample collected from a sand bar at Myers Dam (MDSB01SD).

Refer to Appendix F for the results of two surface water samples collected from the Metaline Falls domestic drinking water intake (MF01SW and MF02SW). MF01SW was collected at the confluence of the intake to Linton Creek. MF02SW was collected at the origin of the spring.

Table 7-1

MINE AND MILL PPE LOCATIONS
LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

MINE	PPE	LOCATION
Blue Bucket (Figure 6-2)	PPE1	Galvanized metal culvert under forest service road entering unnamed creek.
	PPE2	Potential flow from shaft to unnamed creek approximately 5 feet.
	PPE 3	Waste rock pile to unnamed creek approximately 30 feet.
Oriole (Figure 6-4)	PPE 1	20 feet southeast of shaft a spring originates and flows approximately 75 feet before coming into contact with the waste rock pile. The spring then flows adjacent to the waste rock pile. At the base of the waste rock pile is PPE1.
	PPE2	Located approximately 160 feet southeast of PPE1, where the waste rock pile comes into contact with the spring.
	PPE3	Potential overland pathway to Linton Creek.
Josephine Mine (Figure 6-6)	PPE1	Approximately 2 feet southeast of the collapsing wood structure a spring originates and flows approximately 40 feet and joins the Pend Oreille River.
	PPE2	PPE2 is 60 feet long and is the entire length of the waste rock pile which enters the Pend Oreille River.
Grandview Mine/Mill (Figure 6-12)	GMPP04	PPE1 is the overland flow from the mine workings on the upper level to the Pend Oreille River.
	GMPP05	PPE2 is the overland flow west from the tailings pile approximately 300 feet to the Pend Oreille River.
Pend Oreille Mine/Mill (Figure 6-12)	PPE1	The ventilation shaft at the mine is flowing approximately 1,260 feet in a northwest direction towards the Pend Oreille River.
	PPE2	PPE2 is the overland flow in a northwestern direction from TDF-1 through Creek 2 approximately 1,585 feet to the Pend Oreille River
	PPE3	PPE3 is approximately 882 feet long and is the entire length of the waste rock pile that is contacting the Pend Oreille River.
	Potential PPE4	Potential PPE4 is the overland flow in a northern direction from TDF-2 (for approximately 1,260 feet) through Creek 1for approximately 3,906 feet to the Pend Oreille River.

Table 7-2

SURFACE WATER INTAKES WITHIN 15-MILE TDL
LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

Mine	15-mile TDL
Blue Bucket Mine	2
Oriole Mine	2
Josephine Mine	0
Grandview Mine/Mill	0
Pend Oreille Mine/Mill	0

Source: Ecology 2001a

Key:
TDL = Target distance limit.

Table 7-3

PEND OREILLE MINE/MILL SURFACE WATER SAMPLES
LOWER PEND OREILLE RIVER
MINES AND MILLS
PRELIMINARY ASSESSMENTS AND
SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264265	01264266
CLP Inorganic ID	MJ0F10	MJ0F11
CLP Organic ID	NU	NU
E & E Sample ID	NU	NU
Station Location	TCBK01SW	POCK01SW
Description	Background	Release
TAL Metals (µg/L)		
Calcium	**68300**	**130000**
Magnesium	**11900**	**31200**
Zinc	2.5 UJK (3.2 U AC)	**63.2 JL**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample results is elevated as defined in Section 5.

Key:

AC	= adjusted concentration.
BK	= Background.
CK	= Creek 1.
CLP	= Contract Laboratory Program.
E&E	= Ecology and Environment, Inc.
EPA	= United States Environmental Protection Agency.
ID	= Identification.
J	= The analyte was positively identified. The associated numerical value is an estimate.
K	= Unknown bias.
L	= Low bias.
µg/L	= micrograms per liter.
NU	= Not utilized.
PO	= Pend Oreille Mine/Mill.
SW	= surface water.
TAL	= Target analyte list.
TC	= Threemile Creek.
U	= The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 7-4

PEND ORELLE MINE/MILL SEDIMENT SAMPLES
ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264264	01264263	01264351	01264352
CLP Inorganic ID	MJ0F09	MJ0F08	MJ0FK4	MJ0FK5
CLP Organic ID	J0F09	J0F08	J0FK4	J0FK5
E & E Sample ID	01050278	01050277	01050260	01050261
Station Location	TCBK01SD	POCK01SD	POSP01SD	POSP02SD
Depth (in. bgs)	0 - 8	0 - 8	0-8	0-8
Description	Background	Release		
TAL Metals (mg/kg)				
Aluminum	**2960**	**2100**	**476**	**1430**
Arsenic	4.7 U	7.6 U	**17.2**	**11.8**
Cadmium	1.4 JB (1.4 SQL)	**3.5**	**9.8**	**14.6**
Calcium	**202000**	**115000**	**142000**	**175000**
Chromium	**5.7**	**9.2**	**3.0**	**12.5**
Copper	**9.2 JL (11 AC)**	**22.5 JL**	**23 JL**	**165 JL**
Iron	**8120**	**6130**	**56800**	**17000**
Lead	**6.8**	**180**	**351**	**1960**
Magnesium	**7090**	**35500**	**63400**	**57800**
Manganese	**211**	**455**	**202**	**254**
Mercury	0.07 U	0.11 JB	0.09 JB	**0.39**
Nickel	**13.8**	**44.8**	10.3 JB	9.0 JB
Vanadium	11.9 JB (11.9 SQL)	**26.8**	9.0 JB	**20.8**
Zinc	**65.2 JH**	**326 JH (217 AC)**	**3320**	**2610**
Total Organic Carbon (mg/kg)				
TOC	**18800**	**36100**	**62000**	**36100**

Note: Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample result is elevated as defined in Section 5.

Key:
AC = adjusted concentration.
B = The reported concentration is between the instrument detection limit and the contract required detection limit.
bgs = below ground surface.
BK = background.
CK = creek.
CLP = Contract Laboratory Program.
E&E = Ecology and Environment, Inc.
EPA = United States Environmental Protection Agency.
H = High bias.
ID = Identification.
in. = inches.
J = The analyte was positively identified. The associated numerical value is an estimate.
L = Low bias.
mg/kg = milligrams per kilogram.
PO = Pend Oreille Mine/Mill.
SD = sediment.
SQL = sample quantitation limit.
TAL = Target analyte list.
TC = Threemile Creek.
U = The analyte was not detected. The associated numerical value is the contract required detection limit.

Table 7-5

PEND OREILLE RIVER AND TRIBUTARY SEDIMENT SAMPLES ANALYTICAL RESULTS SUMMARY
LOWER PEND OREILLE RIVER MINES AND MILLS PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA Sample ID	01264420	01264402	01264404	01264409	01264414	01264403	01264405	01264406	01264407	01264408	01264421	01264422	01264424	01264070	01264073	01264425
CLP Inorganic ID	MJ0GM9	MJ0GL1	MJ0GL3	MJ0GL8	MJOGM3	MJOGL2	MJ0GL4	MJ0GL5	MJ0GL6	MJ0GL7	MJ0GN0	MJ0GN1	MJ0GN3	MJ0BQ3	MJ0BQ5	MJ0GN4
CLP Organic ID	J0GM9	J0GL1	J0GL3	J0GL8	J0GM3	J0GL2	J0GL4	J0GL5	J0GL6	J0GL7	J0GN0	J0GN1	J0GN3	JX829	JX831	JOGN4
E & E Sample ID	01050244	01050231	01050233	01050238	01050241	01050232	01050234	01050235	01050236	01050237	01050245	01050246	01050248	NU	NU	01050249
Station Location	POBK01SD	PRRS01SD	PRRS02SD	PRRS03SD	PRRS04SD	PRTB01SD	PRTB02SD	PRTB03SD	PRTB04SD	PRTB05SD	PRTB06SD	PRTB07SD	PRTB08SD	US002SD	US003SD	PRTB09SD
Depth (in. bgs)	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 8	0 - 2	0 - 4	0 - 8
Location	Pend Oreille River					Lime Creek	Everett Creek	Ledbetter Creek	Unnamed Tributary	Slate Creek	Peewee Creek	Beaver Creek	Sulllivan Creek	Flume Creek	Flume Creek	Linton Creek
Description	Background	Release														
TAL Metals (mg/kg)																
Aluminum	**11100**	**10700**	**8410**	**6950**	**7660**	**2470**	**3850**	**6610**	**2220**	**3530**	**5720**	**2620**	**8950**	**5120**	**9960**	**5930**
Arsenic	**16.3**	**5.8**	**4.9**	**5.0**	3.0 JB	2.4 U	**5.6**	**16.2**	3.3 U	**8.3**	2.8 JB	2.3 JB	**4.8**	1.5 JB	0.47 U	**6.0**
Barium	**183**	**123**	**85.6**	44.5 JB	**89.7**	105 JB	**91.0**	99.7 JB	109 JB	48.1 JB	57.8 JB	44.2 JB	33.2 JB	34.2 JB	19.2 JB	49.7 JB
Cadmium	0.57 JB (0.57 SQL)	0.51 JB	0.09 U	0.11 U	0.88 JB	1.3 JB	**6.1**	1.0 JB	1.8 JB	0.40 JB	0.19 JB	0.98 JB	0.94 JB	0.35 JBK	0.05 UJK (0.04 U AC)	0.80 JB
Calcium	**21500**	**24400 JL**	**2350 JL**	**3400 JL**	**12100 JL**	**206000 JL**	**59800 JL**	**14700 JL**	**342000 JL**	**49100 JL**	1390 JB	**3610**	**42400**	1160 JBK	915 JBK	**30500**
Chromium	**17.6**	**23.9**	**19.7**	**17.1**	**17.1**	**57.7**	**86.2**	**13.8**	**8.2**	**7.0**	**10.1**	**6.2**	**18.3**	**7.9**	**16.4**	**14.4**
Copper	**25.9 JL (31.6 AC)**	**32.1**	**23.5**	**21.8**	**19.7**	**20.3**	**17.7**	**16.3**	15.8 JB	**12.0**	8.1 JB	4.3 JB	**17.5 JL**	6.1 JBK	**8.7 JK (7.1 AC)**	**16.0 JL**
Iron	**27000**	**21700**	**14400**	**14200**	**14500**	**3240**	**9400**	**16200**	**4170**	**14200**	**15900**	**6700**	**25900**	**14300**	**24500**	**13600**
Lead	**35.7**	**28.1**	**9.4**	**8.3**	**38.5**	**7.1**	**38.7**	**23.2**	**12.7**	**13.6**	**7.6**	**4.6**	**19.0**	**6.4**	**5.0**	**86.8**
Magnesium	**8910**	**11200 JL**	**4660 JL**	**4450 JL**	**7540 JL**	**3060 JL**	**12100 JL**	**7580 JL**	**5680 JL**	**27100 JL**	**2410**	1200 JB	**8510**	**2230**	**4490**	**18700**
Manganese	**921**	**429 JH (346 AC)**	**217 JH (175 AC)**	**209 JH (169 AC)**	**188 JH (152 AC)**	**93.7 JH (75.6 AC)**	**246 JH (198 AC)**	**517 JH (417 AC)**	**217 JH (175 AC)**	**209 JH (167 AC)**	**198**	**107**	**437**	**178**	**235**	**427**
Nickel	**20.9**	**19.2**	**15.6**	**14.1**	**14.5**	8.0 JB	**35.2**	**22.7**	5.6 JB	**20.7**	**17.4**	**12.5**	**26.3**	**19.9**	**20**	**14.2**
Potassium	2020 JB	**1730**	**1340**	978 JB	1180 JB	333 JB	938 JB	1170 JB	533 JB	990 JB	760 JB	405 JB	403 JB	335 JB	233 JB	985 JB
Selenium	1.5 U	0.87 UJK (0.37 U AC)	0.88 UJK (0.37 U AC)	0.90 UJK (0.38 U AC)	1.1 UJK (0.46 U AC)	**4.9 JL**	1.2 UJK (0.50 U AC)	1.7 UJK (0.71 U AC)	2.4 UJK (1.0 U AC)	0.84 UJK (0.36 U AC)	1.1 U	1.4 U	0.86 U	0.76 JB	0.44 U	0.85 U
Vanadium	**28.3**	**41.6**	**32.8**	**31.5**	**21.4**	6.4 JB	**42.9**	**33.0**	8.6 JB	9.0 JB	15.6 JB	**17.4**	12.2 JB	**14.0**	6.2 JB	**25.4**
Zinc	**287**	**130**	**54**	**43.8**	**205**	**58.2**	**342**	**163**	**49.3**	**107**	**60.9**	**59.8**	**263**	**60.0**	**49**	**261**
Pesticides (mg/kg)																
"4,4'-DDT"	6.6 U	4.3 U	4.2 U	4.5 U	5.7 U	10 U	5.5 U	**10**	11 U	4.6 U	5 U	5.2 U	4.5 U	4.2 U	3.8 U	4.3 U
Total Organic Carbon (mg/kg)																
TOC	**13700**	**7610**	**595 J**	**581 J**	**45600**	**74800 J**	**28900**	**48200**	**77300**	**14100**	**5490**	**38100**	**599 J**	1000 U	**1310**	**4270**

Note Bold type indicates the sample concentration is above the detection limit.
Underline type indicates the sample results is elevated as defined in Section 5.

Key:

AC	= Adjusted concentration.
B	= The reported concentration is between the instrument detection limit and the contract required detection limit.
bgs	= below ground surface.
BK	= Background.
CLP	= Contract Laboratory Program.
E&E	= Ecology and Environment, Inc.
EPA	= United States Environmental Protection Agency.
H	= High bias.
ID	= Identification.
in	= inches.
J	= The analyte was positively identified. The associated numerical value is an estimate.
K	= Unknown bias.
L	= Low bias.
mg/kg	= milligrams per kilogram.
NU	= Not utilized.
PO	= Pend Oreille Mine/Mill.
PR	= Pend Oreille River.
RS	= river sediment.
SD	= sediment.
SQL	= Sample quantitation limit.
TAL	= Target analyte list.
TB	= tributary.
TOC	= Total Organic Carbon.
U	= The analyte was not detected. The associated numerical value is the contract required detection limit.
US	= Tributary sediment/soil (upstream/upland sampling location).

8. SUMMARY AND CONCLUSIONS

In June 2001, the START-2 conducted (PAs and SIs of 21 mines/mills located near the lower reach of the Pend Oreille River in Pend Oreille County, Washington. The Pend Oreille River, originating as the outflow from Lake Pend Oreille in Idaho, enters Washington flowing north through the northeast corner of the state into Canada, where it drains to the Columbia River just above the International Border and flows south from Canada into Washington state. The lower reach of the Pend Oreille River is defined for this assessment as the segment of the river beginning at approximately Metaline and ending at Boundary Dam near the International Border. The lower reach of the Pend Oreille River flows through the Metaline mining district and contains a number of inactive/abandoned mines/mills and one active zinc-lead mine/mill. Historically, metal extraction and processing were relatively inefficient, yielding large volumes of metal-rich tailings that were deposited in and near streams.

The purpose of the PAs and SIs was to identify and investigate potential sources of contamination to the lower reach of the Pend Oreille River. Of the 21 mines/mills visited, sampling was conducted at 5 properties. Sampling was conducted at those mines/mills where potential sources of contamination were identified and potential impacts to receptors via the surface water migration pathway were observed.

The PA and SI activities involved the collection of samples from potential hazardous substance source areas and from target areas/receptors potentially impacted through contaminant migration. A total of 64 samples submitted for EPA CLP methods of analysis were collected, including background samples but excluding QA samples. The media sampled included surface soil, tailings, waste rock, surface water and sediment. Section 8.1 summarizes the findings and conclusions for each mine/mill sampled. A list of mines visited but not sampled is presented in Table 8-1. Sampling was not conducted at these mines because no contaminant source was observed and/or no surface water features including overland drainage routes were identified on these properties. Recommendations for these mines are included in Table 8-1.

8.1 FINDINGS AND CONCLUSIONS

8.1.1 Blue Bucket Mine

The contaminant source at the Blue Bucket Mine includes a waste rock pile measuring approximately 60 feet long by 50 feet wide by 15 feet deep. Analytical results of samples collected indicate

that hazardous substances are migrating to targets that include the nearby unnamed creek, the Pend Oreille River, and habitat used by threatened and endangered species. The PPE sediment samples contained significant concentrations of TAL metals including cadmium (2.8 mg/kg), lead (72.5 mg/kg), and zinc (373 mg/kg AC). No containment features such as run off controls exist at the waste rock pile at the mine. Migration of contaminants from the waste rock pile to the nearby unnamed creek may occur via overland flow of runoff water with suspended sediments.

Based on the findings of this investigation, further action under CERCLA or other authorities is recommended to address the migration of contaminants via runoff from the waste rock pile to the unnamed creek.

8.1.2 Oriole Mine

The contaminant source at the Oriole Mine includes up to five waste rock piles with the largest measuring approximately 25 feet long by 15 feet wide by 4 feet deep. Analytical results of samples collected indicate that hazardous substances are migrating to targets including Linton Creek, the Pend Oreille River, and habitat used by threatened and endangered species. The PPE sediment samples contained significant concentrations of TAL metals including cadmium (27 mg/kg), lead (714 mg/kg), manganese (4,120 mg/kg), silver (5.6 mg/kg), and zinc (5,740 mg/kg). No containment features such as runoff controls exist at the waste rock piles at the mine. Migration of contaminants from the waste rock piles to Linton Creek may occur via overland flow of runoff water with suspended sediments.

Based on the findings of this investigation, further action under CERCLA or other authorities is recommended to address the migration of contaminants via runoff from the waste rock piles to Linton Creek.

8.1.3 Josephine Mine

The contaminant source at the Josephine Mine includes a waste rock pile measuring approximately 60 feet long by 10 feet high by 2 feet deep. The START-2 observed that the waste rock pile extends into the Pend Oreille River forming the bank of the river. Analytical results of samples collected indicate that hazardous substances are migrating to targets in the Pend Oreille River, and habitat used by threatened and endangered species. The PPE sediment samples contained significant concentrations of TAL metals including cadmium (9.6 mg/kg), lead (17,400 mg/kg), mercury (0.16 mg/kg), silver (2.3 mg/kg), and zinc (2,040 mg/kg).

The surface water sample collected from a spring that originates from the property and feeds into the Pend Oreille River contained significant concentrations of TAL metals including lead (21.5 ug/L) and zinc (117 ug/L).

Migration of contaminants from the waste rock pile to the Pend Oreille River is occurring via direct overland flow. Based on the findings of this investigation, further action under CERCLA or other authorities is recommended to address the migration of contaminants via direct overland flow from the waste rock pile to the Pend Oreille River.

8.1.4 Grandview Mine/Mill

In October 2000, EPA conducted sampling at the Grandview Mine/Mill. The field event included the collection of samples from three on-site soil source areas including waste rock piles, a suspected tailings pile, and an abandoned container area (Figures 6-8 and 6-9). Samples collected from the waste rock piles contained significant concentrations of arsenic (44.0 mg/kg), cadmium (23.3 mg/kg), lead (4,930 mg/kg), mercury (1.5 mg/kg), selenium (1.5 mg/kg) and zinc (7,420 mg/kg).

Samples collected from the suspected tailings pile contained significant concentrations of cadmium (58.4 mg/kg), copper (91.5 mg/kg), lead (2,260 mg/kg), mercury (1.7 mg/kg; JL), selenium (1,1 mg/kg), and zinc (19,100 mg/kg).

The abandoned container and drum area contained significant concentrations of arsenic (64.9 mg/kg), cadmium (99.5 mg/kg), copper (236 mg/kg), lead (14,600 mg/kg), mercury (6.0 mg/kg), selenium (3.0 mg/kg), and zinc (36,200 mg/kg).

In June 2001, EPA collected PPE surface water and sediment samples. The PPE surface water and sediment samples contained significant concentrations of TAL metals including cadmium (1.6 mg/kg), lead (449 mg/kg), manganese (25.5 µg/L), and zinc (864 mg/kg).

The October 2000 field event included the collection of samples from potential targets along the groundwater migration, surface water migration, and soil exposure pathways including groundwater wells, an unnamed spring, a former waste water drainage ditch, and the Pend Oreille River.

Elevated levels of TAL metals were detected in the Pend Oreille Village groundwater samples, the unnamed spring co-located surface water and sediment samples, the Pend Oreille River sediment samples, and the former wastewater drainage ditch surface soil samples. Concentrations of substances detected in the Pend Oreille Village groundwater samples did not exceed Drinking Water Standards.

Results of the October 2000 and June 2001 sampling events indicate that the Grandview Mine is a source of hazardous substance contamination, including TAL metals. Analytical results of samples

collected indicate that hazardous substances are migrating to targets that include groundwater drinking water wells, the unnamed spring, the former wastewater drainage ditch, the Pend Oreille River and habitat used by threatened and endangered species.

Further action under CERCLA or other authorities is recommended at this site.

8.1.5 Pend Oreille Mine/Mill

Samples were collected from potential contaminant source areas at the Pend Oreille Mine/Mill including three TDFs and one waste rock pile. Three PPE co-located sediment and surface water samples were also collected. Sample locations are shown in Figure 6-12 and analytical results are summarized in Tables 6-7, 6-8, and 6-9.

Soil samples collected from source areas contained significant concentrations of TAL metals including arsenic (40.0 mg/kg), cadmium (44.1 mg/kg), copper (242 mg/kg JL), lead (5,625 mg/kg AC), mercury (0.58 mg/kg), selenium (3.1 mg/kg), silver (2.3 mg/kg), and zinc (9,300 mg/kg).

The PPE samples contained significant concentrations of TAL metals including barium (62.6 ug/L), cadmium (6.1 mg/kg), lead (346 mg/kg), manganese (33.0 mg/kg) and zinc (2,370 mg/kg).

Analytical results of samples collected indicate that hazardous substances are migrating to targets that include wetlands, the Pend Oreille River and habitat used by threatened and endangered species.

Further action under CERCLA or other authorities is recommended at this site.

Table 8-1

CERCLA RECOMMENDATIONS AT MINES NOT SAMPLED
LOWER PEND OREILLE RIVER MINES AND MILLS
PRELIMINARY ASSESSMENTS AND SITE INSPECTIONS
PEND OREILLE COUNTY, WASHINGTON

EPA CERCLIS ID Number	Mine	CERCLA Activity Type	Recommendation
WAN001002331	Sterling	Preliminary Assessment	No further action under CERCLA
WAN001002328	Metaline	Preliminary Assessment	No further action under CERCLA
WAN001002318	Bella May	Preliminary Assessment	No further action under CERCLA
WAN001002320	Diamond R.	Preliminary Assessment	No further action under CERCLA
WAN001002325	Lehigh No.1	Preliminary Assessment	No further action under CERCLA
WAN001002332	West Contact	Preliminary Assessment	No further action under CERCLA
WAN001002326	Lehigh No.2	Preliminary Assessment	No further action under CERCLA
WAN001002321	Hoage	Preliminary Assessment	No further action under CERCLA
WAN001002327	Lucky Strike	Preliminary Assessment	No further action under CERCLA
WAN001002324	Lead King	Preliminary Assessment	No further action under CERCLA
WAN001002352	Z Canyon	Preliminary Assessment	No further action under CERCLA
WAN001002350	Lead Queen	Preliminary Assessment	No further action under CERCLA
WAN001002323	Lead Hill	Preliminary Assessment	No further action under CERCLA
WAN001002349	King Tut	Preliminary Assessment	No further action under CERCLA
WAN001002351	Red Top	Preliminary Assessment	No further action under CERCLA
WAN001002333	Yellowhead	Preliminary Assessment	No further action under CERCLA

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